Vol. 9 JULY, 1915 No. 1

389/6

J. B.

QUARTERLY

OF THE

National Fire Protection Association

Entered as second-class matter May 1, 1911, at the Post Office at Boston, Mass., under act of July 16th, 1894.

87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Active Members.

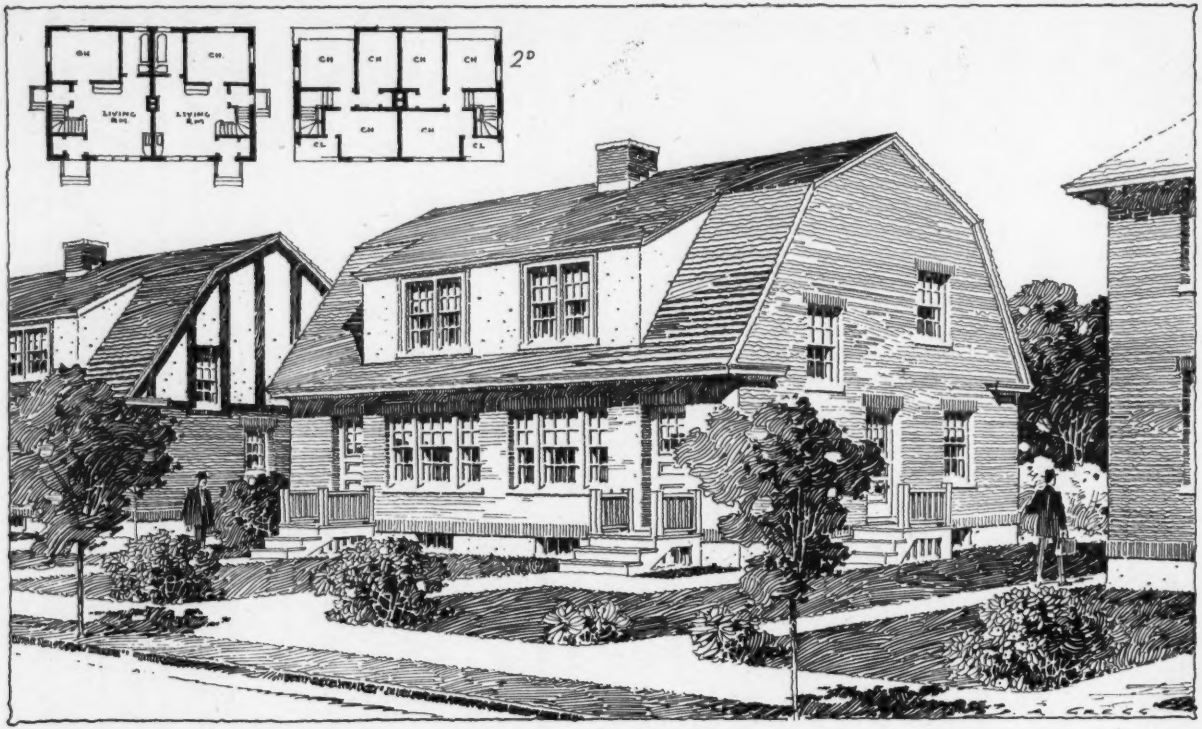
July 1, 1915.

American Institute of Architects.
American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Society of Heating and Ventilating Engineers.
American Institute of Mining Engineers.
American Concrete Institute.
American Gas Institute.
American Electric Railway Association.
American Warehousemen's Association.
Arkansas Actuarial Bureau.
Arkansas Fire Prevention Association.
Associated Factory Mutual Fire Insurance Co's. Inspection Bureau.
Associated Metal Lath Manufacturers.
Association of American Portland Cement Manufacturers.
Association of Fire Underwriters of Baltimore City.
Board of Fire Underwriters of Allegheny County.
Board of Fire Underwriters of the Pacific.
Board of Fire Underwriters of the Territory of Hawaii.
Boston Board of Fire Underwriters.
Buffalo Association of Fire Underwriters.
Bureau of Explosives.
Canadian Fire Underwriters' Association.
Canadian Manufacturers Association.
Chicago Board of Underwriters of Chicago.
Cincinnati Fire Prevention Bureau.
Cleveland Inspection Bureau.
Compressed Gas Manufacturers Association
Cotton Insurance Association.
Electrical Supply Jobbers Association.
Factory Insurance Association.
Factory Mutual Laboratories.
Fire Underwriters' Electrical Bureau.
Fire Underwriters' Inspection Bureau.
Florida Fire Prevention Society.
Georgia Fire Prevention Society.
Gypsum Industries Association.
Illinois Inspection Bureau.
Illinois State Fire Prevention Association
Independent Petroleum Marketers' Association of U. S., The
Indiana Inspection Bureau.
Indiana State Fire Prevention Association
Institute of Makers of Explosives
Insurance Association of Providence.
International Acetylene Association.
International Association of Fire Engineers.
International Association of Municipal Electricians.
Iowa Rating Bureau.
Iowa State Fire Prevention Association.
Kansas Inspection and Fire Prevention Office.
Kentucky Actuarial Bureau.
Kentucky State Fire Prevention Association.
Louisiana Fire Prevention Bureau.
Louisiana State Society for the Reduction of Fire Waste.
Mainland Fire Underwriters' Association of British Columbia.
Massachusetts Mutual Farm Inspection Bureau
Massachusetts Mutual Fire Insurance Union.
Michigan Inspection Bureau.
Michigan State Fire Prevention Association.
Millers' National Federation
Minnesota State Fire Prevention Association.
Mississippi Inspection and Advisory Rating Company.
Mississippi Society for the Prevention of Fires.
Missouri Inspection Bureau.
Missouri Fire Prevention Association.
Mutual Fire Prevention Bureau.
National Association of Building Owners and Managers.
National Association of Credit Men.
National Association of Electrical Inspectors.
National Association of Insurance Agents, The
National Association of Manufacturers of United States.
National Assn. of Master Gravel and Slag Roofers of America.
National Automatic Sprinkler Association.
National Board of Fire Underwriters.
National Commercial Gas Association
National Convention of Insurance Commissioners.
National Electrical Contractors' Association.
National Electric Light Association.
National Founders' Association
National Gas Engine Association.
National Implement and Vehicle Association.
National Lumber Manufacturers' Association.
National Paint, Oil and Varnish Association.
National Petroleum Association
National Wholesale Druggists' Association.
National Wholesale Grocers' Association.
Nebraska Inspection Bureau.
Nebraska State Fire Prevention Association.
New Brunswick Board of Fire Underwriters.
New England Bureau of United Inspection.
New England Insurance Exchange.
New Hampshire Board of Fire Underwriters.
New Jersey Schedule Rating Expert's Office.
New York Board of Fire Underwriters.
New York Fire Insurance Exchange.
North Carolina Fire Prevention Association.
Nova Scotia Board of Fire Underwriters.
Ohio Inspection Bureau.
Ohio State Fire Prevention Association.
Oklahoma Inspection Bureau.
Oklahoma State Fire Prevention Association.
Philadelphia Fire Underwriters' Association.
Philadelphia Suburban Underwriters' Association.
Rocky Mountain Fire Underwriters' Association.
South Carolina State Fire Prevention Association.
South Dakota State Fire Prevention Association.
Southern Cypress Manufacturers' Association.
South-Eastern Underwriters' Association.
State Fire Insurance Commission of Texas
St. Louis Fire Prevention Bureau.
Suburban Fire Insurance Exchange.
Tennessee Fire Prevention Association.
Tennessee Inspection Bureau.
Texas Fire Prevention Association.
The Union.
Underwriters' Association of the District of Columbia
Underwriters' Assn. of the Middle Department.
Underwriters' Association of New York State.
Underwriters' Bureau of Middle and Southern States.
Underwriters' Bureau of New England.
Underwriters' Laboratories, Inc.
Vancouver Island Fire Underwriters' Association.
Virginia Fire Prevention Association.
Western Actuarial Bureau (Fire).
Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
West Virginia State Fire Prevention Association.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

Table of Contents.

COTTAGE CONSTRUCTION IN SALEM, MASS. ..... FRONTISPIECE
EDITORIAL 5
MEMBERS' ACTIVITIES 17
FIRE LOSSES FIRST HALF 1915 21
EXECUTIVE COMMITTEE MEETING 22
FIRE PREVENTION: ITS OBJECT AND RESULT. *C. Heller* 25
THE REBUILDING OF SAN FRANCISCO 31
SAN FRANCISCO EXPOSITION EXHIBIT. *Insurance Field* 36
THE WOODEN APARTMENT HOUSE. *Gorham Dana* 37
INDIVIDUAL LIABILITY FOR FIRE LOSS 44
FIRE ALARM SIGNAL SYSTEMS TO SUPPLEMENT FACTORY FIRE DRILLS. *Committee on Signaling Systems* 48
FIRE TESTS OF MOTION PICTURE FILM CONTAINERS. *F. J. T. Stewart* 56
FOUNDRIES—THEIR PROCESSES AND HAZARDS 76
DEPARTMENT OF FIRE RECORD 83
FOUNDRIES—FIRE RECORD 83
GENERAL FIRE RECORD 102
WATER LOSS FROM SMALL FIRES 111

Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.



Double Brick Cottage Being Erected in Salem. Five Rooms and Bath for Each Family.

See The Wooden Apartment House, Page 37.

See The Wooden Apartment House, Page 37.

Double Brick Cottage Being Erected in Salem. Five Rooms and Bath for Each Family.

FOILING THE DEVOURING ELEMENT.

The fire fighters employed effective means of saving the town hall, which stood but five feet from one of the burning dwellings when they passed a cable about the building, hitched a team of horses to it and dragged it some distance away.—*Zanesville, O., Times.*

The Quarterly

Vol. 9 **July, 1915** **No. 1**

The Nineteenth Annual Meeting. The published *Proceedings* of the Nineteenth Annual Meeting, the 500-page volume now in the hands of the members, is a sufficient voucher of the work accomplished and progress made in the technical and routine work of the Association in its last fiscal year. A larger and more complete representation of active members is indicated by the registry than ever before, and the special reports from the same measure the progress in fire prevention work that many of the new associations in our membership are making.

The innovation of devoting an entire session to a "round-table" discussion of building regulations and the functions of the building inspector was wholly successful, holding the large attendance until after six o'clock. The interest in this feature of the program was largely due to Mr. Sidney J. Williams' personal contribution as the organizer and presiding officer of the session, which resulted in the subsequent formation of a national association of building inspectors to carry on independently the conferences thus begun at the annual meeting of the N. F. P. A.

The round-table conference on the subject of high pressure fire service connections to automatic sprinkler systems was also of prime interest, and general satisfaction was expressed over the fact that its result was a motion which puts the Association positively on record as favoring such connections. The subsequent action of the Executives in requesting Mr. French's committee to work out the details of such proposed connections promises an interesting report and discussion for next year.

Several of the committee reports were unusually voluminous this year, but as they were all circulated to interested members well in advance of the meeting their presentation was by title and they were expeditiously disposed of. The committee on *Blower Systems* completed its tentative report of last year; the committee on *Fire-resistive Construction* presented another section of its work; the committee on *Automatic Sprinklers* brought in a pretty complete revision of the sprinkler rules; the committee on *Explosives and Combustibles* presented a budget of revised specifications; the committee on *Fire Protection Coverings*

for Window and Door Openings offered a complete revision of the installation requirements for such retardants; the committee on *Tanks* offered a complete revision of its sections on *Gravity and Pressure Tanks;* the committee on *Standards* resubmitted its specifications for *Interior Standpipe Systems;* the committee on *Fire Pumps* presented a revision of the specifications for both *Rotary and Centrifugal Pumps* and the *Electrical Driving of Fire Pumps;* the committee on *Uniform Requirements* submitted proposed specifications for *Scuppers*, and the committee on *Manufacturing Risks and Special Hazards* added to its valuable contributions an advisory brochure on *Cold Storage Warehouses.*

The report of the committee on *Safety to Life*, so admirably presented and illustrated by Chairman Forster, made an exceedingly interesting number, following Mr. Cooper's illustrated paper on *Schoolhouse Construction* in the United States.

The first report of the committee on the *Uses of Wood in Building Construction* was naturally tentative, but including as it did the fire tests of the Wisconsin Forest Products Laboratories on treated and untreated wood, the report indicated that no hasty nor ill-considered action need be feared by the lumber interests. The presence for the first time of representatives of our active members the National Lumber Manufacturers' Association and Southern Cypress Manufacturers' Association was gratifying as indicating future co-operation by these members.

The committee on *Signaling Systems* presented the first draft of specifications for fire alarm systems to supplement factory fire drills. The discussion of this report was extended and it was referred back to the committee for reconsideration. This reconsideration was promptly given and the revised draft is printed in this issue of the QUARTERLY.

The luncheon at Hotel Astor so successfully arranged by New York Chapter was a pleasant break in the routine work of the meeting, which is always strenuous—as visitors invariably remark.

* * * * *

Are Committee Reports Hurried? Another feature of our annual meetings, and one which leads astray the feet of the visitor unfamiliar with our methods of handling committee reports, is the presentation of voluminous reports by title. When a stranger at our annual meeting receives for the first time ten minutes before its delivery a report like that on *Fire Pumps* from Mr. Lacount's committee, or *Tanks* from Mr. Dana's, he is amazed at the technical detail of the specifications, and when he sees the Association voting to adopt such reports in a half hour's time he has a bewildered notion that either he is among super-men, or else the country is taking awful chances in following N. F. P. A. standards. As the presiding officer cannot take the time to explain to each new man who comes in exactly how these reports are handled, the latter is apt to conclude that the only discussion on or attention given to these reports by the membership is that which he sees—which is generally confined to the remarks of members who have been too busy or too

indifferent to read the reports previous to the meeting and who preface their remarks by the statement, now of twenty years' standing, that they "have not had time since entering the meeting to prepare themselves to discuss the report." The truth of this statement is frequently obvious from the nature of the remarks, which Chairman Powell Evans referred to rather ironically at one point in this year's discussions as "wandering thoughts," much to the amusement of the members who had diligently studied the reports weeks before the meeting and registered their criticisms with the chairmen of the committees.

It is this belated discussion and the constant effort of our presiding officers to expedite it that seems to leave in the minds of the uninitiated the impression of hasty action, and results in the aftermath of correspondence, of which the following is fairly representative:—

(*a*)

Letter from the Eastern Underwriter, New York (Clarence Axman, Editor), to Secretary Wentworth, June 25, 1915.

We understand that there is considerable criticism of the proceedings of the National Fire Protection Association among its members, based on the belief that the Association attempts to do too much.

The claim is that the committee's reports are now rushed through by headings instead of being read line for line; and in view of the importance of these reports and the fact that they make standard requirements, some people think that eventually there will be some trouble over the standards.

We would appreciate very much having your comment and any suggestions that you would care to make as to increasing the effectiveness of the Association's work. Or do you think that the criticism is entirely unjustified?

(*b*)

Letter from Secretary Wentworth to the Eastern Underwriter, June 26, 1915.

Acknowledging your letter of June 25th, the criticism indicated therein is not at all to the point. Our committee reports are not "rushed through by headings," nor have they ever been hurriedly prepared. The committees preparing these reports are selected from the most competent engineers in the membership of the Association covering the special subjects. These reports are printed in advance and sent to every active member, and a list to every associate member who may obtain a copy if he desires. During the six weeks or two months previous to our annual meeting, these reports are studied by these members, and their criticisms made in writing to the chairmen of the committees. Pertinent criticisms are recognized by the chairmen and amendments made to the printed copy, the same being indicated by the chairmen at the time the report is presented to the annual meeting. The reports having been previously considered by everyone interested before presentation at the meeting of the Association, it is not deemed expedient to read fifty or sixty pages of fine type to the assembled members, who surely would not sit and listen. You will realize, however, that this does not mean that the reports are "rushed through." Anyone who fails to write the committee in advance, can introduce his criticisms at the annual meeting. The reports, in the event of any criticisms, are referred back to the committee and on receipt of the published Proceedings containing the original reports and the criticisms thereon, the members have an opportunity to once more address the chairmen of the committees before the reports are printed and promulgated.

I assume the criticism which you communicate was made by some uninformed person who happened into our annual meeting and concluded that the presentation

of the reports from the platform was the whole performance. We are always very grateful for suggestions from our friends or members calculated to promote interest in or the efficiency of the Association, but we hope this explanation will convince you that the criticisms communicated in yours of June 25th are not to the point.

When a report is referred back to the committee presenting it, and then to the Executive Committee for final disposition, it reaches the latter only by transmission from the former with assurances that all criticisms and suggestions, written or verbal, have received consideration. It is not expected that the executive body shall go into the detail of the report; it is its duty to decide if the report shall be formally published, and opinion on this point is usually influenced by the disposition of the Association itself, or the recommendation of the committee that its offering is or is not sufficiently well digested to warrant publication. No report has ever been formally adopted, printed and promulgated within sixty days of the mailing of the published *Proceedings* to members. If, therefore, members do not avail themselves of the two months' time afforded for reading the proceedings and registering the criticisms they may have to offer on the subjects particularly concerning them, their complaints of the Association's actions merit scant consideration. Publication of standards should not be delayed until they are outlawed by industrial progress.

* * * * *

Concerning Construction Standards.

There is a matter concerning these committee reports, however, which does deserve to receive the thought of the Association, and that is the growing feeling among the members that the formulation of construction rules for certain devices and materials affecting the fire hazard is a matter demanding time and labor from our members which might well be otherwise applied to the greater advantage of the Association.

The proper installation of devices is still a matter which intimately concerns the rank and file of our membership, but the rapid growth of general interest in fire protection has brought into use such a flood of individual devices of such varied character as to make the proper construction details of many of these a matter almost wholly of laboratory investigation and test. Anticipating this contingency, two of our active members, the Underwriters' Laboratories, Inc., of Chicago, and the Factory Mutual Laboratories of Boston, have instituted and developed testing stations fully competent to pass upon the construction details of devices and furnish an opinion as to their suitability for the use intended, and it is the thought of some of our members that the time has come to officially recognize the value of these instrumentalities in which the Association has so long had confidence and to relieve our individual members of arduous committee service in considering technical details in which their interest is no longer centered.

In the early years of the life of the Association and the beginnings of fire protection engineering such committee service was invaluable in out-

lining rudimentary needs and making specifications for home made devices and materials to meet these needs. Modern developments and practice, however, render our original machinery more or less inadequate. It seems to be a growing opinion that the Association should continue to emphasize the character of the results it desires to obtain and indicate the requirements of installation which a proper field practice can verify; but leave to private enterprise and invention the production of devices to mee these requirements under the certification and check of the laboratories established for this very purpose. This would release for larger service to the Association the surplus energies of numerous of our loyal members now heavily taxed in detail work no longer necessary to our objects.

It is not the thought of the members inclined to this policy that the Association should abandon its interest in the proper construction of fire protection devices, but merely to readjust to modern requirements its method of supervising those items which fall logically under laboratory treatment. There are numerous items, such as automatic sprinklers, steel doors and shutters, etc., on which the Association has never attempted construction standards.

The stimulus of our work of public education has liberated energies and given them a very positive direction, and private invention feels oftentimes aggrieved that its offerings of a device cannot be officially considered until the slow-moving machinery of the Association has evolved a standard for devices of its class. We cannot afford to discourage by academic formalities that very fire-fighting intelligence we desire most to develop. We are in a fast-moving world, and when special agencies are created to handle special routine work as well or better than we can, and opportunities for larger service are beckoning, it seems unwise to squander the time of the Association in discussing the number of threads per inch on a set screw. The arrangement made by Underwriters' Laboratories, Inc., under which anyone, anywhere, at any time, may appeal from its decision or opinion on the merits of a device to the Bureau of Standards of the United States Government; and the presence of the Director of the Bureau of Standards on the Executive Committee of the N. F. P. A. seem to be a sufficient guarantee that no injustice will be done to our members or anybody else in matters affecting the construction of devices and materials. The increasing pressure of state and municipal matters upon the executive office suggests that the N. F. P. A. may well consider available relief from technical detail in the matters indicated, and press forward to the consideration of the larger complexities already well above the horizon.

* * * * *

Prospective Membership Changes. The recommendations made by the Executive Committee to the committee on Articles of Association, which appear in the report of the Executives on another page, are sufficiently radical to promise an interesting discussion at the Chicago meeting in 1916. The proposed increase in annual dues is not the radical feature. Such increase has been foreshadowed

for some years. A number of our active members have for some time advocated an increase to $100 per year for this class. While the Executives have been reluctant to take any positive step in the matter, they have realized that since the N. F. P. A. has ceased to be an organization exclusively related to underwriting, the annual contribution of one active member, the National Board of Fire Underwriters, has been larger than is wholly consonant with the dignity of the Association, notwithstanding the fact that the National Board has always punctiliously refrained from any attempt to influence the Association's policies. While the generosity of the National Board has been deeply appreciated, and that body might perhaps fittingly make some helpful recognition of the services of the Association in the preparation of the standards it officially adopts, it has been the thought of the Executives that its previous contributions of $5,000 per year, and its present contribution of $3,500, is larger than any such obligation warrants. The Association is now more valuable to the underwriting fraternity than it has ever been, but it has become equally valuable to the other elements composing it, as well as the country itself. It is the logical university for the fire protection engineer whose profession its activities have created, as well as the common school in which the underwriters' experts and those of the professional, business and industrial worlds may meet and understand one another. The increase of dues of active members from $25 to $50, now advocated by the Executives, will be an item of small consequence to bodies of the character and influence composing the N. F. P. A., and yet this small increased contribution from each, with the added revenue brought in by the proposed division of the associate class, will rescue the Association from the undignified position of financial dependence upon one active member.

The notable change in the articles recommended by the Executives is not the one concerning its finances, but the one looking to the further democratization of the organization by placing upon all members the responsibility of the vote. This innovation, if adopted, will be very agreeable to many of our zealous associate members who have heretofore participated in the discussions but not in the privileges of voting, restricted to active members. The proposition to furnish additional copies of the Association's publications will find favor with many of our active members, some of whom have the habit of writing for duplicate copies of nearly everything the Association prints.

* * * * *

The Point of Saturation. A fact which the N. F. P. A. has for some years attempted to impress upon officials responsible for public safety is that there is what may be called a point of saturation in respect to fire department expenditure, beyond which, in the absence of proper fire prevention effort, the waste is comparable to the fire waste itself. Our San Francisco member, Mr. C. Heller, in his remarkably able report to the board of fire commissioners of that city, of which the section on fire prevention is published in this issue of the QUARTERLY, shows how far San Francisco is transgressing in this direction. In his

letter transmitting his report to the city officials, Mr. Heller makes a point which is applicable to every city in the country and which should be laid well to heart by everyone considering city fire protection or prevention.

Mr. Heller says:—

The first need of a fire department in any city is to protect it from being wiped out by a conflagration, and thereafter its principal function is to keep the fire loss as small as possible. In the accompanying report we have laid particular stress upon our contention that up to a certain point the fire loss will decrease as the strength of the fire department is increased, but after that state of development has been reached, any further strengthening of the department, while affording additional security against conflagrations, will not reduce the annual fire loss. It is our opinion that this stage has been reached in the local department. Therefore, if the fire waste in San Francisco is to be further diminished it can only be done by taking better means to prevent the occurrence of fires and not by merely improving methods for their extinguishment.

It is interesting that the *New York Sun*, on the occasion of the annual parade of the fire department of the metropolis June 12th, should have commented on the same editorially as follows:—

Indicted, and Proud of the Evidence!

Chief Kenlon and his men and apparatus will be on parade to-day for the edification of their employers. We need not say that the men are devoted and skilful, the tools they work with ingenious and well adapted to their purpose. Their numerous excellences are commonplaces; along with all our fellow citizens we accept them as matters of routine.

Why is it necessary to maintain such an elaborate establishment at the public cost? The fact is that the elaborateness of the fire department is an indictment of the population and a reproach to the habits that make it essential. It shows up our practice of carelessness in construction, our confirmed disregard for safety, our ineradicable contempt for caution. Only within a few years have we seriously adopted schemes for fire prevention and sought to enforce obedience to regulations which would reduce the firemen's work to the minimum. For generations we builded without thought of safety, while racking our brains to devise schemes for extinguishing fires. To-day the utmost vigilance is necessary to hold what has been won in construction practices; and the amateur incendiary with lace curtains blowing into open gas jets, burning matches tossed into inflammable materials, piles of greasy waste stored under stairways, heating apparatus set close to exposed woodwork, neglected electric sad irons igniting ironing boards; a thousand methods of burning up his home, his neighbors, and his city, occupies a conspicuous place in our social system. He is responsible for an annual destruction of property that appalls those who bother to consider it, until it is forgotten in the contemplation of the list of dead resulting from his continuous activities.

If we were a practicable people our fire departments would have little to do. We should devote our energy to preventing fires. The policeman on the beat would see to it that the firebugs did not start them. The man whose house burned down, instead of receiving condolences and a check from the insurance underwriters, would wonder how long he would enjoy the benefits of association with Warden Osborne's guests. But we are not practical; and sometimes it seems as if we never shall be.

Such being the case, we have erected the fire extinguishers into a mighty engine that does us every credit. We have spent money liberally on them, and they have given us good value for every penny of it. They know their business and do their work well; and they must smile at a public which lavishes praise on them, and refuses to make any serious effort to render them unnecessary or to restrict the possibilities for their employment.

The progress of every great reform affecting the habits and thought of the people is slow. The above quotations from utterances at the extreme east and west of the continent are significant, however, of impending change.

* * * * *

What is a Fire Wall? As an illustration of the character of many matters which flood the daily mail of the executive office of the Association, we print below a letter recently received from an official of a large Western city which explains itself:—

A difference of opinion has arisen between myself and the Chief Building Inspector as to what constitutes a fire wall.

The Chief Building Inspector admits that the fire wall in case of a flat roof should project through the roof 18 inches or thereabout, but in cases where the roof is pitched, he insists that a fire wall ending at the roof is a proper fire wall.

In my opinion this is absolutely wrong, for the reason that in a building in which a fire wall is required, should a fire occur in one part, communication under the roof to the adjacent building, or part of building, could be very easily made, with serious possible loss.

The importance of this will be readily understood when I say a great many permits have been issued from this office, supposedly under the rules, wherein six or eight stalls are built side by side with walls ending under the roof.

As experts in this line of work, I would respectfully ask your opinion, and also state clearly what the prevailing practice is throughout the country.

As Professor Ira H. Woolson, chairman of our Committee on Fire Resistive Construction, has just finished the revision of the building code of the National Board of Fire Underwriters, and it might therefore reasonably be presumed he would know what a fire wall is, we asked him to reply to this communication. He replied to it as follows:—

The term *fire wall* has had a very elastic interpretation, being used for walls and partitions of varying character. We regret this indiscriminate use of the term, for it has led, and will continue to lead, to confusion so long as the illegitimate use of the word continues.

The term *fire wall* has, in our opinion, a very definite meaning. First of all, it is a wall and not a partition,—we mean by that a substantial masonry structure not less than one foot thick. The purpose of such a wall is to restrict the area subject to the spread of fire. Walls of this character are generally used to divide excessive areas in factories, warehouses, or other commercial buildings, and when so used should have the minimum number of openings a business will permit. Such openings must be protected by standard fire doors upon each side of the wall; no openings other than doors should be permitted under any circumstances, and it must always be recognized that the doorway is the weak point in the wall even when protected as above specified.

In all buildings of non-fireproof construction, fire walls should extend three feet above the roof irrespective of whether the roof is flat or peaked. As the object of such a parapet is to prevent the flames lapping over from one side of the roof to the other, also to furnish a barrier behind which firemen could successfully fight a fire in another portion of the building separated by such fire wall, it is quite evident that the parapet is as necessary upon one type of roof as the other. If the roof construction is thoroughly fireproof in all parts, the reasons for the parapet disappear, and it is then unnecessary for the fire wall to continue above the roof surface; it should, however, have a tight joint with the roof, so as to prevent any possible passage of flame or heated gases from one side to the other.

The height of parapets on fire walls separating rows of dwellings may justly be reduced to two feet, because of the inferior character and small size of such structures.

One of the best known means of furnishing escape from a burning building is a substantial partition of fireproof construction built to divide a floor area in a building where a considerable number of people are employed. Fire doors in such a partition furnish rapid exit from one portion of the floor to the other in either direction, and the partition, if properly built, would restrain the fire in the area in which it originated until the people who had passed through the partition, together with those occupying the opposite side of the partition, would have had ample time to escape by stairways or other approved means of exit. Partitions of this character are often called fire walls, but it is a mistake to do so. A fire wall should restrain a fire an indefinite length of time; a partition of this character is not intended for this purpose. In the revised Building Code we call this partition a "fire exit partition."

It was Professor Woolson who made the motion at the annual meeting for the appointment of a committee on nomenclature, to determine the proper definitions of terms used in fire protection engineering. The fact that officials of a large city need an authoritative definition of a fire wall would seem to emphasize the need for such a committee.

* * * * *

A Hose-Coupling Incident and Suggestion. One of our New York members, Mr. E. B. Mallory, electrical engineer, relates an interesting incident of a recent suburban fire, and contributes a suggestion which may be very helpful to small fire departments of adjacent villages.

Mr. Mallory was present at the fire referred to, which occurred midway between two small residence communities suburban to New York and which necessitated the laying of more hose than could be provided by either of the individual fire companies. He comments as follows:—

After observing the confusion and delay incident to fighting this fire, it has occurred to me that a very small addition to the equipment of rural departments of this character could be made with considerable advantage.

The situation was substantially as follows: The first company arriving on the scene finding that the fire was too far from any hydrants in their community and considerably nearer to a hydrant on the other side of the fire, began laying their hose *from the fire toward the other village*, intending to couple with the hose of the other village fire department to reach the hydrant. As is no doubt customary in small volunteer departments of this character, little thought was given to the arrangement of the fittings on the hose, with the result that when the junction of the two hose lines was reached it was impossible to couple them together and one had to be reversed from that point to the fire.

Had these departments been supplied with two small lengths of hose, even two or three feet long, one of them having sleeve couplings on each end, the other having nipples on each end, it would obviously have been a matter of a moment to insert whichever section applied to the end fitting on the long lines of hose, with the result that water would have been available in a matter of seconds rather than requiring some fifteen minutes to reverse nearly a thousand feet of hose.

Mr. Mallory further suggests that two discarded sections might provide at least a few feet of usable hose and the four necessary brass fittings. A more elaborate form of fitting could be made of an all metallic nature, but would doubtless prove more expensive, while the above makeshift

would be a very valuable piece of equipment to keep on hand, the case applying of course only to the class of department mentioned.

* * * * *

Mr. Robb Pessimistic. Manager Willis O. Robb, of our active member the New York Fire Insurance Exchange, has such unusual qualities of mind, such delicate humor, and such keen insight into economic conditions, that to differ from his carefully written opinion requires much fortitude. His recent speech at Lake Placid, however, wholly stimulating and delightful reading as it is, does not seem to us in its references to the probable result of our fire prevention activity to indicate quite a true perspective. Mr. Robb said:—

> It is approximately forty years since the modern American fire prevention movement began with the introduction of the automatic sprinkler. The development of that movement is familiar to you all. The insurance companies, manufacturers, merchants, municipalities, State and Federal governments, voluntary associations of all kinds, all these forces, acting both separately and in co-operation, have for all these forty years been contributing to that development. And through all the forty years they have been fighting, as to-day they are still fighting, a purely defensive fight, making no inch of real progress. That is to say, the ratio of the annual fire loss to the entire value of the burnable property of the country is to-day substantially what it was forty years ago. We have merely offset, with the money and brains and labor of all these years of fire prevention activities, the hostile forces that have all the time been tending to increase the fire waste of the country to utterly ruinous figures.
>
> We have held our intrenched position, but we have made no gain whatever. It almost seems that whenever the chemists or the electricians or the engineers or the mechanics of the country have registered a new advance in industrial efficiency we have had to detail new corps of fire prevention experts to follow after them and prevent their beneficent discoveries from burning us out of our national house and home. Certain it is that, whether you study the annual reports of the insurance companies and note that the slow reduction in the average rate of premium is offset by the like reduction in rate of underwriting profit, or whether, disregarding insurance entirely, you compare the figures for the increase of wealth with those for the increase in fire waste, you reach the same conclusion, viz.: that the fire loss per dollar of burnable value is not going down, has not gone down, in your time or mine. We remember when a $100,000,000 annual fire loss looked large, and we have come to consider a $200,000,000 one small. To be sure, property values have meantime been doubling, but only doubling. Now, this condition of deadlock, I make bold to say, cannot be indefinitely continued. When the band of missionaries now being recruited and sent forth by the N. F. P. A. has delivered its message throughout the land, and when the public has heard and acted upon that message; when fire prevention day and clean-up day and the prize contest for essays on the national ash heap are firmly established everywhere, and when that public has discovered to its amazement, as I prophesy it will, that all this is getting nowhere, that this desperate upstream pulling is only holding the fire prevention boat opposite the same old stump on the bank, there is going to be one mighty howl of disgust and a demand for a wholly new treatment of the evil. When that demand has done its perfect work it is entirely possible (though I make no prophecies) that the fire insurance business will not be recognizable to its nearest friends of the present generation.

From Mr. Robb's statements of past and present melancholy facts we cannot escape. We may, however, escape his prophesy. In every city in which the new fire prevention inspections are made a radical

reduction in the number of fire alarms is noted. This is significant. The rapidly extending use of automatic sprinklers is significant. Many other items are significant. Effects must follow causes. It would seem to us logical, therefore, if the upheaval in the insurance world at which Mr. Robb darkly hints is really to come, it may be more the result of a proportionally decreased than a stationary or increased fire waste.

* * * * *

Salem a Year After. A year has rolled around since the great fire in Salem left thousands of its people homeless and interrupted the usual activities of that old city. The disaster, whose magnitude was in large measure due to an inadequate fire department, was so great that outside aid had to be asked for, and it was given in generous volume from all parts of the Commonwealth. Time demonstrated that Massachusetts people were willing and able to care for those afflicted within her borders, and that the money voted by Congress was not needed.

The year has seen Salem revolutionized. There are under way more than $6,000,000 worth of new buildings to take the place of those destroyed by fire, and due heed has been taken for safety. Discreditable former conditions have been remedied. The fire department has been reorganized to five-fold its former force, a high pressure water system is to be installed, streets are to be widened, and a new bridge and boulevard are to be built to connect with trunk thoroughfares. A building code has been provided under which safer and healthier dwellings and better factories and business buildings will be secured. A far better city has arisen from the ashes of the old one.

Happily more progressive communities may not have to be taught by a great fire the need for fire protection and sensible building methods. Nevertheless, there are plenty of backward places to which the experience of Salem may well teach a needed lesson. It is doing now what it ought to have done long ago. (*See Frontispiece.*)

* * * * *

Field Practice: Inspection Manual. No better illustration of the signal success of the N. F. P. A. in amalgamating and unifying the fire prevention effort of the underwriting, commercial and official forces of the country is possible than is presented by the popularity of *Field Practice*, the inspection manual of the N. F. P. A. In certain cities large numbers have been privately purchased by the owners of sprinklered properties, over two hundred copies having already found such favor in Cleveland alone. Many of our active members maintaining inspection departments are calling the book to the attention of the managers of properties inspected, as invaluable as a manual for self-inspection reference at times when the official inspectors are not accessible.

The remarks of Chief J. O. Hammitt of the Fire Prevention Bureau of New York City at our annual meeting are an indication of the favor

Field Practice finds in the offices of the state and municipal inspection bureaus.

Chief Hammitt said:—

I want to express in behalf of the fire department of the largest city of the country, with the largest fire prevention problem, our appreciation of the assistance that is rendered to us by delivery to us by the National Fire Protection Association of a book of Field Practice which we can substantially, in the form in which it is presented, adopt as the standard to govern the work of municipal fire prevention. I hesitate to say that Field Practice is the most valuable publication that the Association has yet produced, because that would be an exceedingly broad statement in view of the very many valuable publications of this Association which have been placed before the public. So far as the work of municipal fire prevention is concerned in this city, and doubtless elsewhere throughout the country, this publication is the most useful thing which the National Fire Protection Association has yet provided.

On the other hand, the value of the book to the underwriters is demonstrated by large purchases by the managers of fire insurance companies, certain individual companies having ordered as many as two hundred copies.

The following letter from one of the most able and influential New York managers is typical of many appreciative communications:—

We are in receipt of a copy of Field Practice, the Association's inspection manual. We do not find that we had previously received a copy. I have looked it over and find it to be a very valuable compendium of information covering a very wide range of subjects. It reminds me of the time when I first became a clerk in an insurance agency. I asked for literature to read in order that I might inform myself. There was no literature to supply me. There was not a publication of any sort from which I could glean information concerning the business or the hazards of different risks or processes. I had to obtain my knowledge by individual experience and by asking questions of older men. I think I would have given any price for a publication like Field Practice if there had been any such. It often occurs to me that the young men of to-day, and especially those who ignore the many opportunities which are open to them, do not appreciate their advantages and have no comprehension of the difficulties experienced by the men of the previous generation. I naturally feel impatient when any of our young men, as some do, omit to avail themselves to the full of the splendid opportunities which are now open to them to obtain a real fire insurance education.

I presume that Field Practice is sold at some reduction in quantities. Without waiting to ascertain what the reductions may be I am pleased to give you an order for twenty-five copies for our company, which please forward to us.

We believe it is the mission of *Field Practice* to unify and standardize inspection of the common fire hazards throughout the United States and Canada, and its favorable reception by all classes interested in fire protection indicates this belief has a reasonable foundation. It could never have been sold at its present nominal price of a dollar and a half were its compilation not wholly a labor of love by a devoted committee.

Members' Activities.

The Ohio State Fire Prevention Association is making a fine drive for the standardization of hose couplings and hydrant fittings in Ohio. Its committee on Fire Protection and Water Supplies has published a pamphlet on the co-operative fire fighting of conflagrations, with special relation to Columbus and surrounding towns. On July 20th, with the assistance of Chief Charles J. Lauer of Columbus, an enthusiastic meeting of the fire chiefs of towns and cities in the vicinity of Columbus was held in the interest of this movement, which may well commend itself to the fire prevention associations of the other states.

* * * * *

Frank D. Chase, President of Chicago Chapter, spoke on "Underwriters, Architects and Building Construction" at the annual midsummer meeting of the Illinois State Board of Fire Underwriters, and made a convincing argument for the co-operation of underwriters and architects in all building operations. An interesting personal note in his speech, which should commend itself to the field men who spend so much of their lives in hotels, is the following:—

> It is a misdemeanor in the City of Chicago to call a building fireproof which is not so, and yet there are hotels in the city so advertised in which I would not live if I were given a whole floor as residence.
>
> When I stop at a hotel, I familiarize myself with its construction as well as the location of fire escapes and stairways. If the stairways are enclosed, and the elevator wells are enclosed, and wired glass and proper partitions are used, I accept my room and sleep peacefully. If the building is a fire trap by virtue of its open stairways, I will not occupy a room which is difficult to escape from in case of fire. If every man stopping in a hotel took these precautions, we would have better hotel buildings.

* * * * *

Benjamin Richards, of Boston, chairman Committee on Manufacturing Risks and Special Hazards, has filled several N. F. P. A. speaking engagements during the quarter. Among the organizations addressed on the subject of the Association and its work were the Chamber of Commerce, Bellows Falls, Vt.; the Profile Club of Manchester, N. H., and the Business Men's Association of Pawtucket, R. I. By a coincidence the American Refrigerating Association was in session at Hotel Astor at the same time as the annual meeting of the N. F. P. A., and Chairman Richards was invited to address that body on the subject of the current report of his committee, Cold Storage Warehouses.

* * * * *

The N. F. P. A. has a capable and energetic woman member in Little Rock, Ark., in the person of Miss Mary Honora McCabe, who is

a member of the legislation department of the General Federation of Women's Clubs and chairman of the Fire Prevention Committee of the Arkansas Federation of Women's Clubs. Miss McCabe recently spoke on fire prevention to students and club women at Arkansas University, at the County Teachers' Institute at Newport, and the Pulaski County Teachers' Institute at Little Rock, and is planning to address a number of farmers' institutes during the summer. As chairman of her committee she issued to the club women of her state an admirable "Americanization Day" bulletin in advance of July 4th, which was published in the *Arkansas Gazette* and over one hundred papers of less note. If the women's clubs of America ever take the interest in the fire waste they logically should, it will be brought about by such service as Miss McCabe is rendering our cause.

* * * * *

Many of our members assisted as usual this year in the circulation of our Independence Day bulletin. Manager Clem E. Wheeler, of the Wisconsin Inspection Bureau, distributed ten thousand copies in that state alone; Manager H. L. Phillips, of the Factory Insurance Association, enclosed a copy with a special word of his own to all the clients of his association, and Insurance Commissioner Robert J. Merrill, of New Hampshire, sent copies with form letters to all the boards of fire engineers, newspaper editors and boards of trade in his state. Many other members issued special local bulletins of their own, using the N. F. P. A. facts and figures.

* * * * *

Charles E. Eldridge, of Topeka, recently delivered fire prevention talks before the Rotary Club of that city and the Chamber of Commerce of Pittsburg, Kan. At the latter meeting the new Kansas state fire marshal, L. T. Hussey, also spoke.

* * * * *

Walter H. Bennett, state fire marshal of Illinois, has issued an interesting series of general bulletins distinguished from one another by paper of different color. The subjects of the bulletins and their numbers are:—

(1) Public Buildings, (2) Chimneys and Flues, (3) Gasoline Fires, (4) Explosives, (5) Gasoline Cans, (6) Fires in Business Houses, (7) Suggestions for Schools, (8) The Wooden Shingle, (9) Digest of Fire Escape Act, (10) Motion Picture Exhibitions, (11) Incendiary Fires, (12) Kerosene Oil Lamps, (13) Carelessness with Matches, (14) Starting Fires with Kerosene, (15) Spontaneous Combustion, (16) Dangers from Christmas Trees, (17) Fires in the Home, (18) Electricity.

As these bulletins contain statistics local to the state they have been extensively published by the daily and weekly Illinois press. Following is a quotation from bulletin No. 8, the Wooden Shingle:—

During the hot, dry months of summer and autumn, wooden shingles become like tinder, and many fires are caused by sparks from flues and chimneys alighting on such roofs. During the year 1914 flying sparks caused 1,731 fires in the State

of Illinois, and, of this number, 1,145 were caused by sparks alighting on shingle roofs. These fires caused a damage of $643,841. This amount does not constitute the entire damage caused by the shingle roof hazard, because it only includes the damage to those buildings in which the fires originated, and does not take into consideration the fact that in a large part of the 944 fires reported as having been caused by exposure the original fire was due to sparks alighting on shingle roofs.

The annual issue of such bulletins as these, timed to reach the public in the newspapers at the moment when the hazards treated are most imminent, is one of the most useful services a fire marshal can render.

* * * * *

Mr. Ira G. Hoagland, of New York, member Committee on Private Fire Supplies from Public Mains, recently addressed the Engineers' and Architects' Club of Louisville, Ky., and among other things advocated fixing personal responsibility for fires due to carelessness or neglect.

* * * * *

Robert Adamson, New York's fire commissioner, has created a new bureau in the fire department to be known as the Bureau of Fire Investigation. Respecting the same the commissioner says:—

While its work is indirectly that of fire prevention, there is really no relationship between the work done by the fire marshals, which is purely detective, and the work done by the fire prevention inspectors, which is the work of rectifying structural faults in buildings. This new division of work is much more logical, and will enable the new Bureau of Fire Investigation to develop and establish a strong identity of its own. It is my intention to have it become the strongest detective bureau in the city.

* * * * *

James R. Young, Insurance Commissioner of North Carolina, has issued a little pamphlet entitled, "Gasoline: Its uses and abuses," calculated to be very serviceable to the people of his state. Commissioner Young has developed a Bureau of Fire Prevention in his department.

* * * * *

Mr. Frederic Dannerth, consulting industrial chemist, recently presented a useful paper on the relation of the industrial chemist to fire prevention, before the fiftieth meeting of the American Chemical Society in New Orleans. Among other things he said:—

In the year 1914 there were eleven fires, each of which involved a loss of one half million dollars or over, and which occurred in industries using chemical processes. The list includes three paper and pulp mills; two factories where chemicals were made, and one each of the following: rubber goods factory, motion film factory, meat packing factory, fertilizer factory, glass factory, and one high school laboratory. Here is a total loss of $7,500,000 in plants which should have been more carefully safeguarded by chemists. The industrial chemist should study the hazards of an industrial undertaking so that adequate preventive measures may be adopted.

Mr. Dannerth does the N. F. P. A. the service of scanning its literature and extracting for the use of the journals of his profession the items interesting to them or which he believes should be interesting to them.

E. M. Underwood, of Portland, recently spoke before the Retail Merchants' Association of Albany, Ore., and exhibited the lantern slides which he used so effectively last year in Portland in the agitation which led to the establishment of a fire prevention bureau in the Portland fire department. While the fire record of Portland is still pretty bad, a hopeful showing is made by the fire alarm statistics, the improvement in which may be attributed to the activity of Chief Stevens of the new bureau, who has just been appointed assistant chief of the fire department. The figures show a decrease in the number of fire alarms for June, 1915, of fifty-six per cent over June, 1914. There were no false alarms for the month of June, 1915, and this is the first month that this has occurred since March, 1902. Mr. Underwood reports: "The number of cases of arson prosecuted in court, two; convictions, two; penitentiary sentences imposed, two!"

* * * * *

The N. F. P. A. is brought close to the European War in the death of one of our associate members, Mr. Robert Key, who was killed at the front on or about May 23d. Mr. Key left Canada with the 1st Contingent as Lance-Corporal, in the 13th Battalion of the Royal Highlanders, and received his promotion to Sergeant on the battlefield. He was associated for a number of years with the Underwriters at American Lloyds, both in Toronto and Montreal, and later acted in the capacity of inspector for the office of Messrs. Dale & Co., Ltd., Montreal. Mr. Key was held in very high esteem by his employers and associates, and his loss is very sincerely deplored by our members in Montreal.

* * * * *

Our active member the International Association of Fire Engineers expects a record-breaking attendance at its annual convention in Cincinnati the first of September. Two papers on fire prevention are to be presented this year, one by Chief J. C. McDonnell of the Bureau of Fire Prevention, Chicago, and the other by Secretary Wentworth.

* * * * *

Lurton H. Stubbs, who is organizing a lecture bureau for fire prevention and municipal improvement work, recently gave the first presentation of his moving picture fire prevention talk, "Our Burning Dollars," in Chicago, under the auspices of the Chicago Chapter of the National Fire Protection Association. The lecture was given in the Central Music Hall, and was largely attended. In addition to the insurance men there were large delegations from the Underwriters' Laboratories, the Western Society of Engineers, the Illinois Chapter of Architects, etc.

Mr. Stubbs gave pictures showing the more common causes of fires and the means by which they could be prevented. The views were enlivened with exciting moving pictures of fire department runs, thrilling escapes from buildings and spectacular fires. The activities of the Un-

derwriters' Laboratories were shown with moving pictures of sprinklers, fire door, wire glass window and other tests.

The lecture is to be given before fire prevention meetings, commercial bodies, conventions, etc., and a large number of engagements have already been made. Mr. Stubbs' talk is interesting, entertaining and convincing, and his arguments are strongly enforced by the pictures.

* * * * *

Mr. J. C. Forsyth of New York will represent the Electrical Committee and Mr. H. W. Forster of Philadelphia the Committee on Safety to Life of the N. F. P. A. at the Electrical Safety Conference to be held in Washington in October to consider the National Electrical Safety Code in preparation by the Bureau of Standards U. S.

Fire Losses First Half 1915.

The losses by fire in the United States and Canada for the first half of 1915, as compiled by the *Journal of Commerce*, reach a total of $93,391,000, against $133,018,250 charged against the first six months of 1914. The following table gives a comparison of the losses by fire for the first six months of this year with those of 1914 and 1913, together with the monthly losses for the balance of 1914 and 1913:—

	1913.	1914.	1915.
January	$20,193,250	$23,204,700	$20,060,600
February	22,084,600	21,744,200	13,081,250
March	17,511,000	25,512,750	18,786,400
April	16,738,250	17,700,800	18,180,350
May	17,225,850	15,507,800	11,388,450
June	24,942,700	29,348,000	10,893,950
Total 6 months,	$108,695,650	$133,018,250	$93,391,000
July	20,660,900	17,539,800	.....
August	21,180,700	11,765,650	.....
September	17,919,300	14,383,050	.....
October	14,932,750	14,004,700	.....
November	15,207,600	21,372,750	.....
December	16,126,450	23,507,150	.....
Total for year,	$224,723,350	$235,591,350	.....

Meeting of Executive Committee.

The usual meeting of the executives following the annual meeting of the Association was held in New York City on June 25th for consideration of matters referred to the committee by the Association; for revising the roster of the various committees where necessary, and for consideration of committee reports, finances, communications, etc. The following members were present:—

F. J. T. Stewart, New York, Chairman.
Powell Evans, Philadelphia.
H. W. Forster, Philadelphia.
H. O. Lacount, Boston.
W. E. Mallalieu, New York.
C. H. Patton, Cleveland.
A. M. Schoen, Atlanta.
C. L. Scofield, Montreal.
M. R. Strong, New York.
Louis Wiederhold, Jr., Philadelphia.
Franklin H. Wentworth, Boston, Secretary.

In addition to the usual routine the following items of business were considered and action taken as indicated:—

(*a*) It was VOTED that the twentieth annual meeting be held in Chicago, May 9, 10, 11, 1916. A program committee, consisting of the President, the Secretary and the Chairman of the Executive Committee, was appointed.

(*b*) The BUDGET submitted by the Treasurer was approved.

(*c*) Messrs. H. O. Lacount of Boston, and H. W. Forster of Philadelphia, were elected members of the Nominating Committee, 1916, as per Article 7 *a*.

(*d*) President Allan Robinson of the Allied Real Estate Interests presented by appointment a plan for a fire prevention campaign among the real estate interests of the country to be carried on by the *Real Estate Magazine*. The matter was referred to the Committee on Public Information and co-operation recommended.

(*e*) It was VOTED (member Lacount not voting) that the special report of the Electrical Committee be adopted and the following be transmitted to all manufacturers of cartridge enclosed fuses:—

It is the sense of the Executive Committee of the National Fire Protection Association that the meeting held in New York on March 24, 1915, was unquestionably a meeting of the Electrical Committee as is clearly set forth in the printed call for the meeting as contained in the Secretary's Bulletin, and any action taken at that meeting is considered an action of the Electrical Committee.

So far as the action at the above meeting is concerned in respect to refillable cartridge enclosed fuses, the question is and will be considered to be in the same state as before that action was taken.

There can be no question but that the report respecting refillable cartridge fuses as presented by the sub-committee in the Bulletin and adopted by the above

meeting, was identical in intent and effect with the recommended substitute; that it was intended so to be and was and will be so considered by the Electrical Committee and its sub-committee.

The Electrical Committee will, as always, be ready to receive any information or advice on the subject of refillable fuses or any other matter covered by the Code, and further, the Committee and its sub-committees will continue the investigation of refillable fuses, endeavoring by test and collection of field experience to keep its information, opinions and actions abreast of the times to the end that, in so far as it lies within its power, it may so frame its recommendations as to properly safeguard the use of electricity without unnecessarily restricting the same.

(*f*) The President was authorized to appoint a delegate and alternate from the N. F. P. A. to the Second Pan-American Scientific Congress, Washington, D. C., December 27, 1915, to January 8, 1916.

(*g*) It was VOTED that the Committee on Signaling Systems be requested to give immediate attention to revision of the pamphlet "Suggestions for Protection Against Lightning."

(*h*) It was VOTED that the Committee on Articles of Association consider recommending to the Association amendments to the Articles as follows:—

(1) To increase Active members' annual dues to $50.

(2) To increase the dues of firms, corporations, boards of trade, chambers of commerce, and other organized bodies in associate membership, to $10, designating such members as "Associate Class A."

(3) To make no increase of dues of individuals or libraries, designating such members as "Associate Class B."

(4) To allow all members to vote in the affairs of the Association in the following proportion:—

Active members	10 votes
Associate members, Class A . .	2 votes
Associate members, Class B . .	1 vote

and to furnish to the different classes of membership copies of the Association's publications in the same proportions, where desired.

(*i*) The status of the Chapter organizations reported to the annual meeting by the Committee on Public Information and referred by the Association to the Executive Committee, was discussed. It was VOTED that the President, Secretary and Chairman of Executive Committee be empowered to act in the adjustment of all matters relating thereto.

(*j*) In the matter of a civil action brought by the city of Philadelphia to correct local fire hazards entailed by large unbroken areas, the Secretary was requested to furnish to member Powell Evans all data on the hazards of such areas which may be available in the fire records of the Association.

(*k*) Matter of laws relating to the crime of Arson referred to Executive Committee by the Association (*Proceedings*, 1915; p. 482), was referred to the Committee on Laws and Ordinances.

(*l*) Matter of committee attention to members' criticisms of reports presented at annual meeting referred to Executive Committee by the Association (*Proceedings*, 1915; p. 491), was discussed, and Secretary requested to inform member Richard L. Humphrey of methods followed in the preparation and adoption of such reports.

(*m*) The committee appointed to prepare a testimonial for past president Robert D. Kohn reported the purchase of a handsome clock with a suitable inscription engraved on a silver plate.

(*n*) It was VOTED that the Committee on Standard Hose Couplings and Hydrant Fittings be requested to prepare a standard for the smaller hose couplings: sizes 2, 1½, 1¼, 1 and ¾ inch.

(*o*) Mr. Charles A. Hexamer was appointed to represent the Association at any conferences on gas appliances which may be arranged by the Bureau of Standards U. S. or other organizations.

(*p*) It was VOTED that the Committee on Private Fire Supplies from Public Mains be asked to work out and present to the Association details of the connection of Automatic Sprinkler Systems to high pressure fire service systems.

(*q*) The report of the Committee on Standard Hose Couplings was ADOPTED and republication of the Couplings record authorized. The Secretary was authorized to correspond with the State Fire Prevention Associations and Inspection Bureaus, soliciting their assistance in the work of this Committee.

(*r*) The revised draft of the National Electrical Code submitted by the Electrical Committee was ADOPTED and referred to the National Board of Fire Underwriters for publication.

(*s*) The reports of the following committees were ADOPTED and the installation regulations submitted by the same referred to the National Board of Fire Underwriters for publication:—

(1) Blower Systems.
(2) Automatic Sprinklers.
(3) Tanks.
(4) Explosives and Combustibles:—
  (*a*) Coal Gas Producers.
  (*b*) Internal Combustion Engines.

(*t*) Reports from the following committees were ADOPTED, with recommendation that the regulations submitted by them be referred to the National Board of Fire Underwriters for publication after further consideration by the committees:—

(1) Explosives and Combustibles:—
  (*c*) Storage and Handling of Nitro-cellulose Motion Picture Films.
(2) Fire Protection Coverings for Window and Door Openings.
(3) Standards: Interior Standpipe Systems.

(*u*) Reports of the following committees were ADOPTED:—

(1) Explosives and Combustibles:—
  (*d*) Oxy-Acetylene Heating and Welding Apparatus.
  (*e*) Acetylene Gas Machines and Storage of Calcium Carbide.
  (*f*) Containers for Storing and Handling Hazardous Liquids.
(2) Fire Pumps.
(3) Manufacturing Risks and Special Hazards:
  Cold Storage Warehouses.
(4) Electric Railway, Light and Power Properties.

*Fire Prevention: Its Object and Possible Results.

By C. Heller, Consulting Engineer (Member N. F. P. A.).

The Object of Fire Prevention.

The ultimate object of all fire prevention work is the reduction and elimination of conditions causing the spread of fire, and thereby the waste of property and life resulting therefrom, as well as the drain on the nation by the absolute wiping out of property due to its consumption by fire; and the incidental, though at present time one of the popular, reasons for the formation of fire prevention organizations, the reduction in fire insurance rates which always follows the reduction of fire losses. In order that the vastness of the destruction by fire in this country may be appreciated, a few statistics are given before entering into a specific discussion of the subject under consideration.

Statistics of Fires.

The following table shows the fire loss in the United States and Canada for each year since the San Francisco conflagration of 1906:—

1907	$215,671,250
1908	238,562,250
1909	203,649,200
1910	234,470,650
1911	234,337,250
1912	225,320,900
1913	224,723,350

Or an average loss per year of $225,247,835, which is equivalent to about one third of the total receipts of the United States Government, and over 50 per cent greater than the annual cost of the United States War Department. It is estimated that if the expenditure for the maintenance of fire departments, private fire apparatus, water works for fire extinguishment purposes, and the cost of carrying insurance, the necessity of which is directly caused by fire, be added to the fire losses, the drain on this country on account of fires would amount to nearly $400,000,000 per year.

In 1913 there were in the United States 44 fires of which the loss in each was $500,000 or over, and of which three alone caused a loss of over $4,250,000. In San Francisco 14 lives were lost as a result of fire.

The average fire loss covering a period of five years in San Francisco and other cities of the United States of similar size is given below. In

*From Report by Heller & Wilson to Board of Fire Commissioners of San Francisco (1914).

the same table will be found the cost of the fire departments of the same cities during 1912, as compiled by the United States Census Bureau:—

	AVERAGE ANNUAL FIRE LOSS BASED ON 5 YEAR PERIOD. 1909-1913.			COST OF MAINTENANCE OF FIRE DEPARTMENTS. 1912.		
	Average	Fire Loss.			Cost	
City.	Population.	Total.	Per Cap.	Population.	of Depts.	Per Cap.
Cleveland	580,355	$992,605	$1.71	596,970	$809,773	$1.36
Baltimore	563,761	926,707	1.64	569,560	924,392	1.62
Pittsburg	541,648	988,520	1.82	550,667	1,030,817	1.87
Detroit	483,737	1,296,826	2.68	503,445	888,810	1.77
Buffalo	431,314	1,036,540	2.41	439,666	1,056,591	2.40
San Francisco	424,810	999,775	2.35	433,488	1,562,679	3.60
Milwaukee	384,656	968,694	2.51	400,279	685,235	1.71
Cincinnati	373,237	1,138,483	3.05	387,543	802,671	2.07
Newark	357,891	962,816	2.69	369,317	639,214	1.73
Los Angeles	349,377	946,797	2.71	386,014	479,783	1.24
New Orleans	344,611	558,105	1.62	350,695	505,478	1.44
Washington, D. C.	336,646	497,947	1.48	342,776	653,373	1.91
Minneapolis	311,922	1,350,855	4.34	323,476	530,834	1.64
	Average of group		$2.38			$1.87

The above figures show that notwithstanding the high conflagration hazard prevailing in San Francisco, its fire loss is slightly under the average of twelve other cities of approximately similar size. They also show that there must be something wrong with San Francisco's policy of fire protection when it becomes necessary to maintain a fire department at a cost nearly double that of other communities in order that its fire losses shall not exceed theirs.

The per capita loss of the above group of cities is somewhat larger than that for the entire country, which is about $2.25 per year, or more than six times greater than the annual loss in the principal European countries (34 cents).* Yet it is a well known fact that the equipment and efficiency of our fire departments is much superior to that of any other country. The reason why the fire loss in the United States so far exceeds that of other civilized countries is that our mode of living is reckless and wasteful and fires are lightly regarded, whereas abroad fire is a crime. There it is recognized that what is consumed by flames can never be restored but is lost forever, while in this country we are indifferent to fire and delude ourselves with the belief that insurance pays all the loss,† whereas it is but a means of distributing a tax. We seem to prefer to pay the premiums for the insurance which indemnifies our neighbor for his loss by fire caused by his own carelessness instead of passing laws and providing for their enforcement by the establishment of fire prevention bureaus which would, by compelling our neighbor to build safely and maintain his premises in a clean and orderly manner, reduce the danger of fire not only to his property but also to that of the entire community. Carelessness is the most productive cause of fire in this country. Its

*The United States destroys or permits to be destroyed by fire more property than any civilized country, and our national fire losses, in proportion to our insurable values, are from six to twenty times those of any European nation.—*Illinois Joint Leg. Report, 1911*, Page 904.

†The fire loss is a direct tax on every industry, on every piece of property, and, indirectly, on every individual—*Minnesota Comm. Hartigan, 1910*.

prevalence is due to the lack of personal responsibility on the part of those whose negligence permits fires to start.

A man on whose premises a fire originates from avoidable causes after his failure to comply with the local fire prevention ordinances should by law be financially liable for a part of or all the damage to the adjoining property, and to the city for its cost in extinguishing the fire.*

All American cities take great pride in their fire departments, and indeed we have in the past decade reached the highest state of development both as to type of apparatus and efficiency of personnel, and this country has without doubt built up the greatest fire fighting forces ever known, but with what result? The result is a fire loss of one quarter of a BILLION dollars per year. In European countries, with what we consider antiquated apparatus, the fire loss is one sixth of ours. And what is the reason for this great difference? It is the fact that they do not have many fires, and without fires there is no need of expensive equipment and large bodies of men to handle the same. While we have been spending our time studying how to build newer and more powerful types of apparatus and how to get larger appropriations for their maintenance, and also building great wooden cities, foreign countries have been studying the resistance to fire of the materials of construction, and have taken advantage of the latest knowledge of construction and based upon such knowledge have enacted modern building laws. They have as a result not only built substantial cities, but they have thereby minimized their fire loss, the insurance tax, and the cost of living, not by fire fighting, but by FIRE PREVENTION.

According to figures compiled by the Federal Government in 1907, the cost of maintenance of fire departments in the larger European cities having an aggregate population of 15,074,432 was $3,069,688, or 20 cents per capita. For cities of the United States having a combined population of 29,250,000 the total cost of fire departments in 1912 was $47,385,546, or $1.62 per capita for fire department maintenance. In San Francisco the cost per capita for fire department maintenance was $3.55 for 1913. During the same year the fire loss in San Francisco was $977,188, equivalent to a per capita loss of $2.21, based on a population of 440,606, and with the cost of the fire department a total tax on the community of $5.76 per inhabitant or 47.4 cents on each $100 of assessed valuation, based on a total value of $536,000,000 as estimated by the Board of Supervisors in preparing the budget for this city for 1914.

Mention has been made of the cost, the efficiency and the accomplishments of American fire departments, yet as a matter of fact under the policy that has been until recently universally followed in this country, that of regarding the fire departments purely as fire fighting agencies, they have not been a success, for our fire loss has increased at a greater rate than our population. In the period of 1880 to 1910 the population

*The New York Fire Department some time ago ordered the installation of an automatic sprinkler equipment in a building owned by the Greenwood Cemetery Co. The order was not complied with. A serious fire subsequently broke out in this building, which the fire department estimated cost $1,500 to extinguish. The City of New York was successful in a suit to recover that amount from the owners of the property.

of the United States increased 83 per cent, its fire loss 187 per cent, with a per capita increase of 56 per cent.* The science of fire fighting has not kept abreast of the times, for unlike that of medicine it has remained content with fighting the disease, while medical science has sought out its causes and reasons for its spread and based upon the knowledge gained is constantly providing means for the prevention of its occurrence. Until the same procedure is adopted by the fire departments of cities no real progress will be made in the reduction of their fire losses.

It is not the intention to convey the impression that large fire departments are not necessary, for it will be many years before the establishment of fire prevention measures will permit of a reduction in the cost of upkeep of American fire departments because of the large areas of inflammable buildings in our cities. A fully equipped fire department must always be on hand prepared to combat conflagrations, which require large bodies of men and large volumes of water for their extinguishment, but fire prevention does have the effect of diminishing the chances of conflagration, for it reduces the frequency of fires. The conflagration hazard is ever present in all of our cities, and it would seem wise instead of spending so much money to fight these disasters that a reasonable amount might be appropriated to prevent them. Neither fire departments nor insurance companies insure against fire or conflagration. The former attempt to extinguish them, the latter partially collect and distribute their cost.

It has already been brought out that the majority of fires in this country result from carelessness, the number being variously estimated at from 30 to 80 per cent † of the total, and is generally taken at about two thirds. Neither laws nor other measures can entirely overcome the failings of human nature and abolish carelessness. Nevertheless, if two thirds of all fires have this cause as their origin it is probably not presumptuous to assume that by a strict enforcement of proper fire prevention regulations negligence could be checked and the causes favoring the spread of fires removed to the extent of a total reduction in loss of 50 per cent.†† Applying these figures to the local fire loss, which for the last five years has averaged approximately $1,000,000, would mean a saving in property value alone of $500,000 per year, an amount surely worth making some effort to conserve to the taxpayers of the city. This saving would be in addition to any lowering of insurance rates which would follow the reduction of losses.

*UNITED STATES FIRE LOSSES.

	Population.	Fire Loss.	Per Capita Loss.
1880	50,155,783	$74,643,400	$1.49
1890	62,947,714	108,993,792	1.73
1900	75,994,575	160,924,805	2.12
1910	91,972,266	214,003,300	2.32

† When testifying before the Metropolitan Fire Hazard Commission, the Chief of the Boston Fire Department stated that in his opinion "at least 85 per cent of all fires are caused through carelessness."

†† More than half of all fire waste in this city unquestionably arises from easily preventable causes. —*1913 Report of Philadelphia Fire Marshal.*

Testimony was given that at least 50 per cent of the fires occurring to-day could be prevented by taking certain simple and inexpensive precautions. Some experts placed the percentage of preventable fires as high as 75 per cent.—*Report of New York Factory Investigating Commission, Vol. I, p. 38.*

The Results of Fire Prevention.

The full value of fire prevention laws cannot, of course, be obtained immediately upon their enactment. They can but gradually educate the public, change its indifferent attitude toward fires and still more slowly change its careless habits, yet from the very start they have an appreciably good effect, for they cause the removal of accumulated rubbish and other conditions which have long prevailed that invite the ignition of fires. While it is the claim* of all those who have studied the subject that fire prevention measures are of great economic importance, in that they help to conserve the nation's resources, the establishment of these claims *as a fact* must come from the fire records, for they alone can conclusively prove the benefits resulting from fire prevention by showing a steady decline in the number of fires and in the per capita loss. Compulsory fire prevention has not been in force sufficiently long in any part of the United States for its effectiveness to be shown in figures, but in order to indicate what it has accomplished in even a short time, we quote below opinions and extracts of reports of those who have had the opportunity of observing the changes in conditions in their territory as the result of the enforcement of fire prevention ordinances.

Ohio was one of the first states to take legislative action for the enforcement of fire prevention laws. In that state the city of Cincinnati "began the work of building inspection with uniformed firemen in May, 1912. About four fifths of the 80,000 buildings were inspected, resulting in a complete elimination of fires originating in cellars, basements and attics of inspected buildings, and so far as they have been able to determine, resulting in a reduction in the fire loss of about 40 per cent, as compared with the ten year average, notwithstanding the occurrence of several large fires since the system was put in operation."

The Fire Marshal of Illinois in his Third Annual Report says: "I believe that if the Chiefs of Fire Departments of the cities of Illinois would delegate two or three of their most capable men as inspectors and keep them busily engaged in this work the fire loss in the state of Illinois would be reduced 50 per cent."

According to the report of 1913 of the Fire Marshal of Philadelphia, "Inspection of properties by the active fire fighting force was inaugurated February 14, 1913. Since that date 75,000 buildings have been inspected and reinspected, corrections and improvements effected. . . .

"The active firemen have been given opportunity and required to learn the structural and physical conditions and nature of the contents of the properties adjacent to their fire stations, thus enabling them to enter all such buildings with more speed and safety, when necessary in a haze of smoke and darkness, because of the knowledge gained during inspections as to locations and condition of stairs, elevators, entrances, etc. The total amount of fire loss during the year (1913) was $2,247,949, a decrease of $883,463, or 28 per cent from that of the previous twelve

* The inevitable result of property inspection will be a large reduction in the city's loss from fire in the near future. This is not a prophecy from an over-confident fire marshal but a statement based on the experience of other cities and states.—*Fire Marshal of Philadelphia. Report of 1913.*

months . . . and the fire loss per capita $1.40, whereas in 1912 our per capita loss was nearly $2. As emphasized in the last report of the Philadelphia Fire Prevention Commission, there certainly can be no great progress made in abating fire waste of life and property unless corrective and preventive efforts be applied to property before the fire occurs, instead of confining the city's activities to extinguishing and investigating fires after they occur. . . It is apparent, therefore, that we must do more than deal with incendiarism, we must reduce fire losses, if they are to be reduced, by cutting down the hazard."

In his report for 1913, to the Fire Commissioners of Baltimore, the Chief of the Fire Department states that the fire prevention bureau, established on October 29, 1913, at once secured a very material reduction in fire hazards.

The deputy fire marshal of one of the Eastern States, having charge of fire prevention measures outside of the larger cities, when referring to fire prevention work being done by his bureau, stated to us that their relations with the underwriters and insurance companies were cordial, but not with the adjusting agencies, for the reason that on account of their bureau there were fewer fires and consequently less adjusting to be done.

The Chief of the Fire Department of Montreal, Canada, has prepared a tabulation showing the results of the inspection work of his department for several years before and since the establishment of fire prevention work, which was started in October, 1908. In Montreal inspections are confined to the congested value district, so that the following figures are particularly interesting, as they show the reduction in the number of alarms in the district covered by inspection, with an increase of alarms in the sections of the city where there is no inspection.

Year.		Population.	No. of Alarms Congested Dist.	Total No. Alarms for City.
1906	No Inspection	320,000	217	1,613
1907	" "	360,000	239	1,739
1908	Inspection	373,000	163	1,669
1909	"	389,837	117	1,759
1910	"	456,000	89	2,143
1911	"	466,197	77	2,717
1912	"	530,437	62	2,665

In its report for 1914 the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters expresses itself as follows: "It is in the latter activity, providing for a fire prevention bureau as a part of the paid fire department with periodical inspections by members of the uniformed force, which holds forth some hope that our losses in large communities will be decreased, and your committee would record its hearty approval to their establishment in every city that has a paid fire department."

The foregoing is a general explanation of the purposes of fire prevention and the results that it may be expected to bring about.

The Rebuilding of San Francisco.

A member of the N. F. P. A. visiting San Francisco in the spring had this to say of the Exposition city:—

San Francisco spends millions on fire protection, but up to 1909 the last report at that time showed she was rebuilding for a fresh conflagration. One hundred and forty million dollars had been expended in buildings of which 86 were first class, costing twenty millions and 7,193 were altered and repaired; 1,417 were new buildings, Class C construction, rather inferior, costing $45,500,000; 113, Class B, fairly good and 13,444 were frame construction, $55,000,000 worth. Fuel for another conflagration. A trip to San Francisco to-day will show cheap, flimsy apartment houses going up in a city which boasts its intelligence and pride.

As this seemed rather a severe indictment of a city about to extend its hospitality to the world we called upon members of the N. F. P. A. resident in San Francisco, Messrs. Heller and Wilson, consulting engineers, for an opinion as to the merits of the criticism, and we have from Mr. C. Heller a table of figures in which he has included for comparison the figures given by our visiting member.

Building Construction Statistics, San Francisco.

Class of Building		According to Visiting Member 1906–1909	Official May 19, 1906–Dec. 31, 1909	Official May 19, 1906 Dec. 31, 1914	Percentage of Total Cost.
A	Value	$20,000,000	$21,547,260	$33,455,004	13.5
	Number	86	96	179	
B	Value	.....	8,472,871	14,807,486	5.9
	Number	113	115	200	
C	Value	45,500,000	48,775,267	82,930,348	33.3
	Number	1417	1585	2794	
Frame	Value	55,000,000	59,959,224	98,785,995	39.7
	Number	13444	14534	26039	
Alterations	Value	.....	10,624,017	19,036,486	7.6
	Number	7193	8295	24917	
Total	Value	$140,000,000	$149.378,639	$249,015,319	100.
	Number	22253	24625	54129	

It will be observed that the figures given by the visiting member are approximately correct.

In explanation of the above table it should be stated that the figures on cost of construction are based upon the values of building permits issued by the Board of Public Works. Such values are probably at least five per cent less than actual cost of construction, as the permits are generally issued before the contracts are let and are therefore based on estimated and not actual costs. It should also be stated that in the above figures the values are for buildings constructed by individuals or private corporations and do not include construction contracts entered into by the United States Government, the city of San Francisco, or the Panama-Pacific Exposition Company, the latter three during the year 1913 having entered into contracts amounting to over $11,000,000. Private contracts during the same year amounting to $21,517,468.

Briefly described, Class A buildings are the usual fire-resistant type of building which may be constructed in any part of the city to an unlimited height, Class B is reinforced concrete construction which may be built throughout the city, but is limited in height to 102 feet, Class C buildings are the usual brick and wood joist construction and are limited to 84 feet in height, but may be built in any portion of the city excepting that their use is excluded for schools, hospitals, or places of public assembly seating more than a thousand persons. Frame or wooden buildings are permitted outside of the fire limits and may be built three stories and basement, but not exceeding 40 feet in height.

Commenting upon the report of the visiting member, Mr. Heller says:—

The essence of the criticism is that whereas San Francisco spends large sums for fire protection it has permitted an excessive amount of wooden construction, thereby creating an unnecessarily severe fire hazard.

In this regard such criticism is largely justified, and there is little doubt that this city has lost an opportunity (by its failure to adopt proper building restrictions within the area or at least a portion of the area denuded by the conflagration of 1906) to create at least in the high value district a section in which only fire-resisting buildings could be erected. Under the present laws buildings of low fire-resisting qualities adjoin those of the best type, with the result that there is no conflagration barrier. We (Heller and Wilson) have always been in favor of setting aside a portion of the congested value district, no matter how small, in which only standard fireproof buildings could be erected, such a district to form a nucleus which would in time be extended so that finally the business sections of our cities could be made practically free of the conflagration hazard. There can be little question that by reason of the large amount of money spent in this city in wooden construction the danger of conflagration in the high value district is materially increased, especially because the wooden district is to the windward of the fire limits.

While in its reconstruction San Francisco may not have adopted building laws based upon the most recent scientific knowledge or experience, is it any worse than other American cities, and are not practically all of our cities continuing to build in a manner inviting future conflagrations? The visiting member refers to the "cheap and flimsy apartment houses going up in the city which boasts its intelligence and pride." It is true there is an excessive number of cheap and flimsy apartment houses which are a discredit to the city, but it is equally true and disgraceful that the same type of buildings will be found in almost every other city in the country. For buildings in which more than three families are domiciled the building code of the National Board of Fire Underwriters should be adopted.

The present laws allow buildings of excessive height and area when the easy rescue of the inmates in case of a rapid fire is considered.

It would not be fair to give any description of the local fire hazard without making some mention of the large sums spent in fire protection. The city of San Francisco has just completed at a cost of $5,200,000 what is probably the most modern high pressure system in existence. Although its population is less than half a million it spends for the maintenance of its fire department and the purchase of new apparatus more than $1,500,000 per year, or a per capita cost of $3.60 as compared with an average for all cities of the United States of $1.62.

While Mr. Heller's loyalty as a citizen moves him to make as good a defense of his city as a man of his experience with fire hazards can make, he does not spare San Francisco in his exhortations to his fellow townsmen themselves. He takes the city severely to task in an article published in the journal of the San Francisco Chamber of Commerce, in which he emphasizes the following lines:—

San Francisco spends for *fire fighting* over one and one-half million dollars a year. For *fire prevention* it spends *nothing!*

The spot-light indictment of San Francisco's policy as illustrated by the information furnished by Mr. Heller is that she is placing a stupendous annual fire tax upon all her people to provide common safety from fire hazards that ought not to exist. Other cities have jerry-builders, it is true, and their influence with city councils is notorious—the recent cunning attempt to repeal the newly extended fire limits law in Boston is a case in point—but it was hoped that San Francisco had learned something at the cost of her own suffering and the impoverishment of the nation which she drained so heavily. She evidently has not. She is not only heavily taxing her people, rich and poor, for protection from the fire traps she is permitting to go up, but her carelessness in matters of detail long since adjusted by most other first class cities is so great as to inspire consternation.

In the *San Francisco Municipal Record* for June, 1914, is printed a report to the Board of Fire Commissioners on fire-hazard conditions in the city. This report is also by our members, Heller and Wilson. The recommendations of the engineers to the Board are as follows:—

We are much impressed with the constantly increasing danger of conflagration and loss of life in this city due to the prevailing building conditions. Although prior to 1906 the area covered by wooden structures was not quite as great as it is now, new conditions have arisen on account of the change in the mode of living. Many wooden and some brick apartment houses have been erected outside of the fire limits, thereby causing a denser population in certain sections, and on account of there being a larger population within a small area many new local business sections have been built. With these have come the usual special hazards incident to mercantile and manufacturing establishments. But with these new conditions have not come new laws to safeguard person and property. The consequence is that in and adjoining buildings in which many families are compelled to live are all sorts of hazardous occupancies, which make the danger of larger fires much greater than ever before. It is our opinion that unless the building laws of the city are changed, so that there will be a much stricter regulation of the manner in which business is conducted in the class of buildings mentioned, in those already constructed, as well as those hereafter erected, and that unless proper means of exit are furnished in buildings already occupied that it is but a matter of time

when there will be not one, but a series of fires attended by unnecessary loss of life. The proof of the above statement is best illustrated by the fire on June 5th, 1915, on California Street adjoining the Bradbury Apartments. This fire started in a paint shop adjoining a four-story wooden building which had over seventy living rooms, and in which the stairway and elevator shaft were immediately adjoining the wooden walls of the paint shop, so that shortly after the start of the fire the same were not accessible. Had this fire occurred a few hours later when most of the people in the neighborhood would have been asleep it would not have been discovered so promptly, and there can be no question but that there would have been considerable loss of life. Further, the firemen on arriving would have been so occupied rescuing people that the fire would have made much greater headway before any streams could have been directed upon it. We therefore recommend that your Board take the necessary action to have an ordinance passed which will require that whenever a hazardous business is to be conducted in a wooden building when said building adjoins another occupied for living purposes that permission for the conducting of said business must first be secured from the fire department, and that the granting of said permission shall be dependent upon the construction of the building in which the business is to be conducted. We also recommend that no wooden building over three stories in height be permitted to be used as an apartment or hotel building when business is conducted on the ground floor, unless the ground floor of said building is of fireproof construction, also that no stores or business be conducted in any hotel or apartment house over four stories in height unless the basement and first floor of said building is entirely of fireproof construction. It is our opinion that with very few exceptions the hotels and apartment house buildings in this city are not provided with adequate exit facilities in case of fire, and that the fire escapes now being used are of a form which would be of small practical use in case of fire, once it had a fair start, and that they give a false sense of security. We therefore recommend that in all buildings of the type in reference three stories or over in height at least one stairway, and all elevator shafts, if any, be enclosed from the ground to the roof in a brick or other fireproof enclosure. There is attached hereto a report of a recent fire in Boston in which eight lives were lost in a building typical of the higher grade of apartment buildings in this city. Similar results may be expected to occur here on any night. The recommendations contained in the report are worthy of your very careful thought.

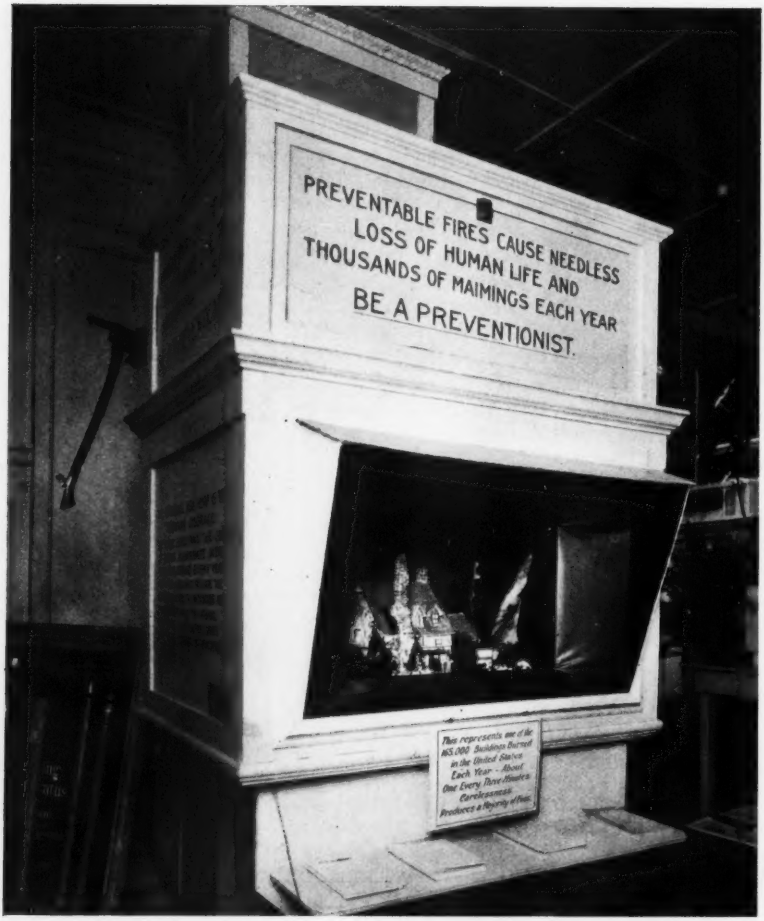
Another dangerous condition has arisen in the past few years, and unless some steps are taken to abate it will undoutedly result seriously in the future. It is the ever increasing number of garages being built in buildings used for dwelling purposes. These private garages are not subject to strict inspection and regulation as are public garages, and are frequently maintained in a careless manner, with gasoline and oils scattered on the floors, and kept in unsafe receptacles. We therefore recommend that no automobile be permitted to be stored or kept in any building, regardless of construction, in which three or more families live, unless the room or part of the building in which one or more automobiles are stored be entirely of fireproof construction and to which there be but one entrance, and that by the street. Under no circumstances should any public garage be permitted in a structure of which any part is used for living purposes.

The revelations made in this report are amazing. Since it was written an ordinance has been passed prohibiting the operation of *public* garages in dwellings, and the Board of Fire Commissioners then in office which took no action on the report has been dismissed by the mayor.

The conditions criticised in the report do not seem, however, so much the fault of the commissioners as a body as the result of a policy which has been permitted to become established. It is that the duties of the fire commissioners are confined to the management of the fire department as relates to the purchase of apparatus, the business and financial

control of the department, and acting as a trial body for members against whom charges have been preferred. They do not make it their special business to study the fire hazards of the city with a view of taking the necessary steps to reduce them, and there is no person or commission whose specific duty it is to do this. The chief of the fire department claims to perform such functions, but the conditions that prevail are the best proof of his lack of accomplishment along these lines. This is not necessarily a personal criticism of the chief, who is reported to be an able fire fighter, but he obviously has neither the time nor the training to cope with these fire prevention problems.

Under date of April 17th of the current year another interesting and voluminous report was filed by Heller and Wilson with the present Board of Fire Commissioners in which the fire prevention laws and organizations of Eastern cities were set forth and in which the recommendation was made for the establishment in San Francisco of a bureau of fire prevention. Action on this report and its recommendations is awaited with interest by those inside and outside of the Exposition city who realize her present dangers and her present inaction respecting them.



This is an illustration of a fire prevention feature of an exhibit at the San Francisco exposition. The *Insurance Field*, published at Louisville, Kentucky, planned and maintains the exhibit. The building inside the container represents a typical California bungalow with wooden frame and roof. The opening for the image is six by eight feet. The building "burns" every three minutes to represent the frequency of fire necessary to consume the 165,000 buildings burned in the United States per year. It is made realistic by the clever use of electric lights and silk floss for flames. Fire starts in lower floor, spreads to second and roof. As it bursts through roof the occupants rush out and deposit furniture and goods upon the lawn.

The exhibit is seen by an average of 2,600 visitors per day.

The Wooden Apartment House.

The Fight Against "Three Deckers" in Brookline.

By Gorham Dana (Member N. F. P. A.).
Manager Underwriters' Bureau of New England.

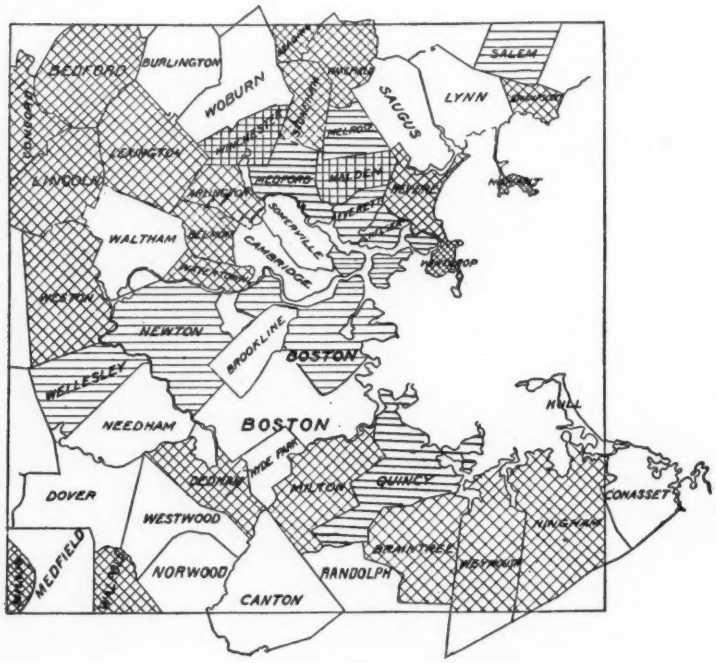
Brookline, Mass., is a town of 30,000 inhabitants and 5,000 voters. It prides itself upon being the richest town in the country as well as one of the largest. Surrounded on three sides by the city of Boston, it refuses to be annexed to the metropolis because it prefers the old-fashioned town form of government. The fact that the town hall will hold only one fifth of the voters is, however, becoming a rather serious problem and will probably be solved in the near future by adopting the rather unusual form of government known as the "modified town meeting."

Two years ago an able committee of five citizens, who had due regard for the fire hazard, revised the Brookline building code. This code was a good one except in one particular, it did not bar out the "three decker." The three decker, an all too common form of construction in Eastern Massachusetts, is a three-family frame tenement, three stories high. At the time the new building code was adopted it was thought that public sentiment would not stand for such a radical step as this. In the past two years, however, public sentiment has greatly changed. The conflagration of Salem, following closely upon that of Chelsea, aroused public sentiment in regard to the fire hazard of three deckers. The many other undesirable features of this type of construction so impressed a number of citizens that a campaign of education was waged against this type of building with considerable success. The Brookline Town Planning Board offered an amendment to the building laws at the annual meeting in March of this year which would require all tenement houses to be of second class or brick construction. There were many other important matters to be considered at the meeting, and the opponents were able to defeat the measure temporarily by having it referred back to the Planning Board. No one really believed that it needed further consideration, but it came up late in the evening, and a majority of the tired citizens who were left thought this an easy way to dispose of it temporarily.

The Town Improvement Committee of the Brookline Education Society then determined to wage a strong fight for the amendment. Four devoted members of the committee met weekly for two months.

A map was prepared giving a plan of the Boston metropolitan district, showing the towns and portion of the city itself in which the erection of

frame three-family houses had been prohibited. A reproduction of this map is here given.



Boston Metropolitan District.

Towns with crossed lines require fireproof tenements (Brookline now added).
Towns with single lines require brick walls in three-story tenements.

Twenty-three towns have adopted the Massachusetts Town Tenement House Act, which requires not only fireproof walls, but fireproof construction throughout. These towns are: Arlington, Bedford, Belmont, Braintree, Concord, Dedham, Hingham, Lexington, Lincoln, Millis, Milton, Nahant, North Andover, Reading, Stoneham, Swampscott, Walpole, Watertown, Wenham, Weston, Weymouth, Winthrop and Wakefield. Revere has adopted the Tenement Act for Cities.

In addition, Newton, Salem, Everett, Framingham, Wellesley, Medford, Melrose, Quincy, Chelsea and Springfield prohibit tenements with wooden walls, and Winchester and Malden require complete fireproof construction. The fire limits of the city of Boston which surround the northeasterly half of Brookline also forbid wooden tenements.

By this map it was shown that Brookline was one of the few remaining municipalities near Boston permitting wooden apartment house construction. It was a graphic illustration of the reason why builders of these cheap structures had transferred their activities to Brookline.

The next step of the Committee was to publish a pamphlet setting forth clearly the arguments against this form of construction and giving facts and figures to prove that it was a poor form of investment.

The contents of this pamphlet were as follows:—

THE ARGUMENTS AGAINST WOODEN TENEMENTS.

(*A*) THEY INCREASE THE FIRE RISK.

Wooden buildings not only increase the fire risk, but cause a greatly increased expense for insurance, fire apparatus, hydrants and water supply.

The insurance rate for wooden three-family houses in Brookline is 21 cents per $100, and for brick three-family houses 14 cents. In Cambridge the rates are 22½ cents and 16 cents respectively. The excess in rate in Brookline on wooden three-family houses over brick is therefore 7 cents, which is $4.90 per year per house valued at $7,000. This is the interest at 4½ per cent on $109, for one year.

The Report of the National Board of Fire Underwriters for 1911 shows the following:—

	Boston	Philadelphia
Population	687,812	1,574,000
Annual Fire Loss (5-year average)	$2,500,000	$2,172,000
Loss per capita	$3.81	$1.45
Annual Cost of Fire Department (5-year average)	$1,496,631	$1,341,220
Cost per capita	$2.17	$0.90

The building regulations in Philadelphia are very strict; and the buildings are chiefly of brick. In Boston frame dwellings predominate.

In the larger European cities the average cost for maintenance of fire department is about 20 cents, as compared with $1.35 in the United States. This difference is principally due to the prevalence of wooden construction here as compared with Europe.

The fire loss per capita in 1913 was, for the United States, $2.25; France, $0.49; England, $0.33; Germany, $0.28; Holland, $0.11;—and largely for the same reason.

In Chicago the city is divided into sections, and whenever any section has more than one half its lots built upon, then wooden buildings are prohibited. This is true even in a section consisting chiefly of wooden buildings, in order that brick buildings may be sandwiched in among the wooden ones to act as fire stops. If this policy had been pursued in Chelsea and Salem, the great destruction in those places would have been avoided. In Denver, the one wooden house erected in the last twenty years is pointed out on the sightseeing automobiles as one of the curiosities of the city.

There is nothing in the argument that fires do not originate more often in wooden than in brick buildings. The danger is from the spreading of fire to adjoining buildings. Nor is it sound argument to say, as has recently been said, that the fire loss in the tenement district of Dorchester is less than the average fire loss in the city of Boston. The danger is always there, as the high insurance rates show. That a serious fire has not occurred in Dorchester and Roxbury, but did occur in Chelsea and Salem, is a mere matter of chance.

The time is coming in the near future when it will be absolutely necessary to stop the erection of wooden buildings in Brookline. Why not stop it now, and let all future builders start even?

(*B*) COST AND DEPRECIATION.

Cost. There is no hardship in compelling owners to erect tenements with fireproof walls, for the reason that a wooden tenement deteriorates so fast that the additional first cost is quickly saved.

Reliable estimates, based on actual bids (Boston, 1914), show that the additional cost for fireproof walls over wooden walls is as follows: 12-inch brick walls, 13%; 10-inch brick hollow walls, 9.1%; stucco on hollow block, 6.3%. A comparison of two similar three-flat houses recently erected in Dorchester showed a cost of $6,000 for wood and $6,379 for brick,—an excess for brick of 6%.

The Building Department of Chicago in 1912, after a very thorough canvass of the matter, reported that for ordinary buildings the excess cost of brick was 10%, and for very cheap buildings, 15%.

In 1912, in New Haven, Hartford, Stamford and Chelsea the average cost of brick houses for 1,729 families was $2,127; and of wooden houses for 2,021 families, $2,138.

Depreciation. A recent canvass of twenty-two insurance companies, insurance agents, builders and architects showed in their opinion an average depreciation of 1½% per year for brick and 2½% for wood. Other estimates were 1 to 1½% for brick and 5% for wood. On the cheaper class of wooden buildings, 5% is probably the more correct figure.

In February, 1915, the Lloyd-Thomas Company, which had just completed an appraisal of the city of Wilmington, Del., amounting to $73,000,000 of assessed values, communicated to the Building Committee of the Chicago City Council the results of their findings as to the depreciation of the various classes of buildings as follows:—

> "In the better residence, the average age of the brick was nine years and the depreciation was 4%, there being no depreciation in the first five years and it being 1% yearly after that.
>
> "In the frame, the average age of the better class residence was fifteen years. The physical depreciation was 20% and the obsolescence 10%. Obsolescence is partly due to going out of style and this is due largely to lack of architectural planning. The total depreciation was 30%.
>
> "In the middle class residence, the average age of brick and frame was the same, fifteen years, and the total depreciation of the brick was 20% and the frame 45% or two and one fourth as great in the frame.
>
> "This comparison may be made more clear by stating in another way. The depreciation of the brick showed that it had a total serviceable life of eighty to one hundred years and the frame thirty-three to forty years. Of course, as a matter of fact and common practice, buildings are seldom entirely used up and the practical usable life of each would be about two thirds of this, or about twenty-five to twenty-seven for the frame and sixty-seven years for the brick.
>
> "In the tenement, the ages did not average the same, the brick ranging from twenty-seven to seventy-five years and the total depreciation being fifty per cent, or one half the original value, the building averaging fifty years old. The frame ranging from ten to forty years in age, the depreciation being 70%."

In other words, they found that brick tenements deteriorated on the average 1% a year and the wooden tenements nearly 3%.

If we take 12% as an average excess cost of building in brick, and 2% as the average annual excess depreciation in wooden tenements over brick tenements, it is obvious that after six years the brick building is the better investment. In other words, wooden tenements are built to sell, not to own. The original builder, who sells them while new, makes something; subsequent owners lose.

It is significant that an important contracting firm in Cambridge, which has built all kinds of buildings for others, has recently erected for itself a number of

six-family tenements, and has built them of first-class (fireproof) brick construction. These flats rent for $20 a month.

Wooden tenements require nearly double the annual outlay for repairs and painting of that for brick buildings. One result is that they are often not maintained as they should be. In that case, to the ugliness of cheap construction is added the ugliness of unpainted and dilapidated buildings. Buildings of brick or stone are better looking to begin with, change much less in appearance, and require much less in the way of repairs.

It should be remembered that it is not necessary to compare a detached wooden three-flat house with a brick three-flat house in a block. It is not necessary that brick houses should be built in blocks.

(*C*) EFFECT OF WOODEN TENEMENTS ON VALUES.

Because a wooden tenement is a fire risk, and a bad investment in itself, as well as being often unsightly, it has a bad effect upon surrounding land values. This is shown by the great fall in values in Dorchester and Roxbury in wooden tenement districts. On the other hand, in Brookline and elsewhere, where land owners have come together and restricted against these buildings, there has been a marked rise in values as compared with unrestricted areas.

The man who puts a wooden tenement into a residential neighborhood of single houses is really enriching himself, temporarily, at the expense of his neighbors. Their open spaces make his tenement more attractive. This is only temporary, for as soon as wooden tenements increase, as they soon do, all values begin to fall.

The owner of the wooden tenement then finds that not only is his building depreciating and the value of his land diminishing, but his taxes are going up. This is because the town is losing the taxes it might have secured from better buildings and sustained land values; and is obliged to raise the tax rate on all property. The owner loses on his building and his land value. For a time he may be able to shift his taxes on to his tenants, **who then have to pay for the privilege of living in a poorer building.** After a time they move to a better building, and then the owner begins to lose on his rent.

(*D*) THE QUESTION OF RENT AND RETURN.

The principal arguments that have been advanced in favor of wooden tenements are: (1) that they afford an attractive investment for persons of moderate means; and (2) that they afford cheaper dwellings than better built structures.

From what has been said above, it is clear that the wooden tenement is not a good permanent investment for any man, rich or poor. After a few years he is actually beginning to lose money on it. The only important consideration is whether the additional first cost of 10 to 15% is a sufficient obstacle to make it a burden to a large number of citizens.

If that is an argument, it is certainly less valid in Brookline than in many other places. Brookline has no large industrial population. The workmen in its largest industrial plant do not live here. But the wooden three flatter is not for the poor man. The rents in it run from $25 to $45 per month. Persons who can pay such rents ought to be able to pay the 10 to 15% additional first cost of a brick building.

But it is believed that the tendency to erect wooden tenements is a habit based on a superficial study of the matter; and that in fact attractive brick houses, either detached or three in a block, or houses for two families one above the other, can be built so as to bring in as good a return at the same rental. As soon as such building becomes more common, rent will be even cheaper than it is now.

The average cost per family of wooden tenements is perhaps $2,186. Brick tenements in East Boston for 112 families, recently erected, with 12-inch walls and equivalent space and improvements, cost $2,200 per family.

The following table comparing wooden three-deckers recently erected not far from Brookline Village, two-family brick houses now being erected at Salem, and blocks of three brick cottages already erected at "Woodbourne" on land of the Boston Dwelling House Company, at Forest Hills, seems to confirm the comparative costs cited above from Hartford, New Haven, and other places. To reduce these various costs to a common measure of housing for six families, the table considers the cost of two three-flatters, of three Salem double houses, and of two Woodbourne blocks. The land in each case has been figured at 40 cents per foot, the three-flatters occupying 6,000 feet, the Salem houses 12,000 feet, and the Woodbourne blocks 8,000 feet. The cost of the Salem houses has been adjusted to give the same floor space as the three-flatters, and the cost as given is a little too large. It should be noted that whereas the wooden apartments occupy practically all of the lots, the Salem houses had nearly 2,000 feet of yard for hanging clothes and for a playground for children. It is assumed that the same rental could be obtained in each case. The result is as follows:—

Wooden three-flatters; 5 rooms and bath, no heat; 1,300 sq. ft.	
Cost of two buildings	$14,500
Land, 6,000 feet @ 40 cents	2,400
	$16,900
Average rent $31 per flat per month, or $372 per year per flat, or for the six flats	$2,232
Per cent which gross rental is of cost	13.2%
Salem brick houses; 5 rooms and bath, no heat; 1,300 sq. ft.	
Cost of three houses	$15,968
Land, 12,000 feet @ 40 cents	4,800
	$20,768
At same rental	$2,232
Per cent which gross rental is of cost	10.7%
Woodbourne blocks; 6 and 7 rooms, bath, with heat; 1,400 sq. ft.	
Cost of two blocks	$20,400
Land, 8,000 feet @ 40 cents	3,200
	$23,600
At same rental	$2,232
Per cent which gross rental is of cost	9.5%

At first sight, this seems to show an advantage for the wooden apartment; and it is this first sight which sells the house. The Lloyd-Thomas Company, in their report to the City Council of Chicago mentioned above, say that brick buildings well built, as they would have to be under the building laws of Brookline, show no depreciation for the first five years, and 1% per year thereafter; but that wooden tenements show a depreciation from the start of 2½ to 3%. Other authorities place the depreciation of wooden buildings from 2½ to 5% per year.

If we call the depreciation of a wooden three-flatter 2½% per year, it is evident that after one year the Salem houses begin to be a better investment than the wooden apartment. After ten years, the former have depreciated 5% and the latter 25%. In less than two years, the Woodbourne blocks have become a better investment than the wooden three-decker. It is true the taxes are less on the latter; but the insurance is more, and in a year or two the depreciation not only of the building, but of land values (as shown in Dorchester), makes the taxes of no account.

The appearance of the town is a matter of great importance to everyone. If it is a fact that not only can brick houses, single or three in a block, or two-family,

be erected so as to bring in substantially the same returns as the wooden tenement, at the same rent, but that the former can be made far more attractive, the case is proved. We ask you to compare the cut of one of the Salem houses used in the foregoing comparative table with the average wooden three-flatter. (See frontispiece.)

Wooden Three-Flat Apartments Recently Erected in Brookline.

Some six thousand copies of this pamphlet were printed and copies sent to all registered voters. The committee then prepared a petition to the Planning Board to hold a hearing on the subject and took steps to secure a large attendance.

The Board of Selectmen was then petitioned to call a special town meeting to consider the proposed amendment. Believing that a large majority of the citizens favored the change, the committee bent its

energies to getting them out. This was done by getting about twenty persons to telephone some one on each important street, asking him to telephone everyone on his street. A postal card reminding citizens of the time of the meeting and asking them to vote for the amendment was also sent to a large proportion of the voters the day before the meeting.

The results were even more than had been hoped for. The citizens turned out in force, filling the town hall to overflowing. The opposition argued that the three decker was a desirable type of home for the poor man, and while admitting that it might not be necessary in all parts of town, offered an amendment that it be allowed in certain zones. This was defeated 587 to 344. They then argued that it would be a great hardship upon the owner of a three decker not to allow him to rebuild if his home burned. Also that the fire hazard of a three decker was no greater than that of a 2½-story single family frame house. The first argument was answered by the statement that in case such a house burned it could be rebuilt in brick at from 8 to 12 per cent increased cost and a much better investment would be secured. Reference to the new building code of the National Board of Underwriters, which for the first time bars out three deckers, was made in answering the second argument. It was stated that they were a greater hazard because they contained more families and therefore more common hazards, because they contained more combustible contents, and because as a matter of practice they were built closer together than single houses.

After unsuccessful attempts to pass other amendments, the opposition finally gave up the fight and the amendment passed by a large majority. The committee then saw to it that the measure was submitted to the attorney general of the state for approval without delay. After being passed by him it was advertised for three successive weeks in a local paper, as required by law, and then went into effect on June 19th.

It is interesting to note that about ninety permits for buildings of this type were taken out between the time the amendment was passed and the time it went into effect.

Individual Liability for Fire Loss.

Progress in Law-making and Court Decisions.

In undertaking its campaign to create a public sentiment in favor of holding individuals personally liable for damage done by fires due to carelessness or neglect the Committee on Public Information was aware of the common law principle that a man is responsible for any damage to the property of his neighbor resulting from his carelessness; but it was obvious that in the minds of the public this principle had not yet extended to damage done by fire. It seemed wise that litigation on this point should be encouraged, and favorable court decisions sought. The result of the wide educational effort of the committee is already being registered

in successful suits at law under the common law, and in the passage of laws and ordinances fixing the expenses of extinguishing or attempting to extinguish fires due to carelessness upon the person or persons responsible. This latter principle is, of course, wholly new to American jurisprudence, and that its successful enactment into the laws of one state, and municipal ordinances of a large city, has been secured is evidence of a rapidly developing public sentiment.

Pennsylvania is the first state to enact such a law for cities of the second class requiring a person, firm or corporation to pay the cost of extinguishing or attempting to extinguish a fire originating on his or its premises, provided the fire was the result of criminal intent, willful negligence or a failure to comply with any law or ordinance of the city or any lawful regulation or requirement of the state or municipal authorities for the prevention or the spread of a fire. The penalties for arson and the fines for the violation of laws, ordinances and regulations remain as hitherto. The new law provides for a civil action to reimburse the city for the expense incurred by the fire department and is an addition to all existing penalties and fines. The new law, already in force, reads as follows:—

STATE OF PENNSYLVANIA.

AN ACT

Imposing certain liabilities on persons, firms and corporations in cities of the second class for the cost of extinguishing fires which occur through their criminal intent, design or willful negligence, or where they have not complied with any law, ordinance or other lawful regulation for the prevention of fire or the spreading thereof, providing a method for the ascertainment of such cost and the manner of collecting the same.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same:* That where a fire originates on the premises occupied by any person, firm or corporation as a result of his or its criminal intent, design or willful negligence, or where said person, firm or corporation has failed to comply with any law or ordinance of said cities or any lawful regulation or requirement of any State or municipal authority enacted or made for the prevention of fire or the spreading thereof, such person, firm or corporation shall, in addition to the present penalties for the punishment of persons convicted of arson or the payment of any fine or penalty for the violation of any law ordinance or lawful regulation or requirement of any State or municipal authority enacted or made for the prevention of fire or the spreading thereof, be liable in a civil action to said cities for the payment of all costs and expenses of the fire departments of said cities incurred in and about the use of employes apparatus and materials in the extinguishment of or any attempt to extinguish any fire originating as aforesaid. The amount of such costs and expenses shall be determined by the Director of the Department of Public Safety based upon the wages of the firemen and other officers for the time they were engaged in the extinguishment or the attempt to extinguish such fire, a reasonable amount as rental for the use of the apparatus of said city; and the cost of the water or other materials used in the extinguishment or the attempt to extinguish such fire, with an additional amount of ten per centum on the total amount as aforesaid as supervisory or overhead charges, all of which shall be paid into the City Treasury for the use of said cities.

SECT. 2. All acts or parts of acts inconsistent with this act be and the same are hereby repealed.

Approved the sixth of May 1915 by the Governor.

It will be noted that this law applies to cities of the second class only and has not yet therefore a wide application to the state. It was passed on the initiative of Pittsburgh and reflects the progressive spirit of the Pittsburgh Department of Public Safety, which desired such a law and did not wish to encounter the hostility of Philadelphia by including cities of the first class in the bill. Philadelphia was urged to ask for an amendment to the bill while it was under consideration by the legislature, thus securing its application to cities of the first class, but did not respond.

The passage in Ohio of a law of similar character applying to all cities of the state was hoped for, and was discussed by the Chamber of Commerce of Columbus without definite result. The authorities of the city of Cleveland believing state action unlikely this year, went ahead on their own account and secured the amendment of city ordinances, so that Cleveland is now the one American city outside of Pennsylvania having such a law. The ordinance is as follows:—

CITY OF CLEVELAND, OHIO.

ORDINANCE NO. 35,989.

Be it ordained by the council of the city of Cleveland, state of Ohio:

SECTION 1. That sections 1577 and 1578 of the revised ordinances of the city of Cleveland be amended to read as follows:

SECT. 1577. It shall be the duty of the fire wardens in their respective districts to examine carefully and at all times during the year every house, store or building, and places for the keeping and deposit of ashes and to ascertain and report to the prosecuting attorney or the police court all violations of the preceding sections; and when any fire warden shall deem any building, chimney, stove, stove pipe, hearth, oven, boiler, ash-house or apparatus used or suffered to be used in any building or manufactory unsafe, or shall discover within his district any cause or condition from which immediate danger of fire may be apprehended, he may either remove or abate the same, in case of the neglect or refusal of the owner, agent, occupant, lessee or person in charge thereof, after being directed to do so, or he may serve written notice upon such owner, agent, occupant, lessee or person in charge thereof, directing such measures as will render the same more safe against fire, and the owner, agent, occupant, lessee or person in charge thereof shall comply with such order of the fire warden within the time fixed by the warden. Provided, however, that such owner, occupant, agent, lessee, or person in charge of such building, shall be entitled to appeal from such order to a board consisting of the director of public safety, and the chief of the fire department whose decision shall constitute the final order to be complied with.

SECT. 1578. Any person violating any provision of any of the foregoing sections of this chapter shall, on conviction thereof, be fined in any sum not exceeding fifty ($50.00) dollars and be further fined in the sum of three dollars ($3.00) for every day said violation shall continue, and in addition in case of fire resulting directly or indirectly from any omission or neglect to properly comply with the written order of the fire warden as provided in the next preceding section, the person or persons culpable or negligent in respect thereto shall be liable in a civil action for the payment of all costs and expenses of the fire department incurred in and about the use of employes, apparatus, and materials in the extinguishment of any fire resulting from such cause, the amount of such costs and expenses to be fixed by the director of public safety and when collected to be paid into the general fund of the city of Cleveland.

SECT. 2. This ordinance shall take effect and be in force from and after the earliest period allowed by law.

Passed June 1, 1915.

Effective July 12, 1915.

In order that an ordinance such as the above might be regarded as all that was necessary to establish full personal liability, the Committee on Public Safety of the Cleveland Chamber of Commerce asked the attorney general of Ohio for an opinion as to the personal liability of an individual for a fire starting on his premises or from damages caused by its spread. Following is the attorney general's opinion:—

> At common law, one employing fire as his agency, or upon whose property a fire has been accidentally or without his fault started, who fails to exercise ordinary care under the circumstances to prevent its spread to neighboring property, or one who negligently or carelessly starts a fire, is liable in damages to another for injury to person or property, of which injury such fire or its spread is the proximate cause.

A recent verdict by the supreme court of New York State, sitting in Syracuse, imposed a personal liability to the extent of $51,608 to cover a loss by fire where negligence was charged. The action was brought by the Globe Malleable Iron & Steel Company and a score of fire insurance companies against the New York Central Railroad. The damages were allowed because a freight train crew refused to break a train and allow the fire department to pass through during a fire, thereby delaying its arrival at the burning property. In charging the jury, the judge presented two questions as to the railroad's liability. The first was whether the corporation was guilty of negligence in obstructing the street with a freight train, thereby hindering and delaying the fire department in its efforts to get at the fire. The second question was, if the railroad company was guilty in that respect, whether its negligence was the proximate cause of the loss of any part of the property burned. The jury gave an affirmative answer to both questions. Evidence was adduced to show that the freight train was three hours late and was endeavoring to make up lost time.

Another decision was handed down recently by the courts in St. Louis County, Mo., showing the new trend in court rulings to hold personally liable for losses by fire those who by neglect or carelessness caused the damage. A man was burning leaves on his property when the wind blew the sparks across the street, setting fire to a dwelling. The owner of the dwelling, who carried no insurance, brought suit against the man who started the bonfire, and was given judgment to the amount of $3,500.

That a man has the right to burn his own house in Texas, was the opinion handed down by the Texas court of criminal appeals at its last session. But in the event there is carried insurance on the house or that any damage should result to adjoining property, then there is a violation of the law relating to arson.

Asserting that three boys, playing with burning corn cobs and sticks that had been saturated with gasoline, set fire to a pile of straw and burned a bailing machine belonging to him, a farmer has filed suit in the circuit court at Frankfort, Ind., for $1,000 damages against the three boys and their parents.

The National Association of Credit Men in annual convention in Salt Lake City in June, endorsed the N. F. P. A. campaign to enforce

personal responsibility for preventable fires. The Association thinks that it will be a long hard fight to get this principle recognized, but it regards it as so important as to be worth the trouble.

It is obvious, however, from the passage of the law and the ordinance above given, and from the increasing number of suits at law to recover damages for fire loss, the successful recognition of the principle of personal liability may not be hopelessly far off.

One of our English correspondents, Mr. Philip F. Brooks, vice president of the Norwich Insurance Institute, has sent us a most interesting pamphlet, indicating long and painstaking research in tracing the idea of personal liability for fire loss to its historic sources. This can be loaned to any of our members so especially interested as to desire to read it.

Fire Alarm Signal Systems to Supplement Factory Fire Drills.

The Committee on Signaling Systems submits herewith to members a revised draft of the proposed regulations for fire alarm systems to supplement factory fire drills, the original draft of which was submitted to the annual meeting. (See *Proceedings*, 1915, p. 193.) At its recent meeting called for this purpose the Committee considered carefully all criticisms and suggestions brought out by the discussion of the report, and all written communications on the subject filed subsequent to the meeting. The Committee believes that the regulations below represent the best ideas for these systems yet formulated.

It is the thought of the Executives to defer formal adoption and general circulation of these regulations, however, while thus making the same accessible to members for their tentative use where desired, and for their further study and criticism.

FIRE ALARM SIGNAL SYSTEMS

for use in

Factories, workshops and institutions where occupants are under discipline and control.

(These regulations are not considered generally acceptable for hotels, apartment houses or department stores.)

FIRE ALARM SIGNAL SYSTEMS.

1. General.

(*a*) All devices and equipment constructed and installed under these rules and requirements shall be expressly approved for the purpose for which they are intended.

(*b*) The sound of the signals of sounding devices of the fire alarm system covered by these rules and requirements must be clearly distinguishable from that of all other sounding devices installed in the same building.

(*c*) Where the same boxes provide for both local and fire department signals, the boxes must be so designed that no unauthorized person can send a local alarm without simultaneously sending the fire department signal.

All boxes in any one factory building should, whether of the same or different type, perform the same functions when normally set, and all boxes in any one factory building shall be set in operation for an alarm in a simple and uniform manner.

Exception may be made to this rule by the inspection department having jurisdiction in cases where it is proposed to add to an existing system a second system performing added functions.

This section is to provide against test boxes, local alarm boxes, general alarm or fire department boxes being installed promiscuously in a building, all readily accessible to the occupants with a possibility of a mistake being made in the right box to be pulled in sending an alarm. The need of a uniform method of turning in an alarm and one with which employees are acquainted is apparent.

(*d*) Fire alarm system must be used for no other than fire protective purposes.

(*e*) All sounding devices, alarm boxes, relay boxes and alarm box enclosure cases must be finished in red to distinguish them from other signaling apparatus.

(*f*) Before acceptance may be obtained for any proposed equipment the building owner must file with the inspection department having jurisdiction a general description of the apparatus, together with such detailed information and drawings as are necessary for a complete understanding of the installation and operation of the system.

If the inspection department requires it, the building owner shall also furnish:—

First.—Specifications, wiring diagrams and floor plans in duplicate, showing the complete equipment, including the source of electrical energy and the location of fire alarm boxes, signaling devices, exits, stairways, elevators and partitions, also the make and type of fire alarm equipment to be used and a schedule of signals indicating each floor. A copy of the approved plans and specifications will be returned as authority to proceed with the work.

Second.—A satisfactory guarantee as to the maintenance, operation and efficiency of the system.

2. Workmanship and Supports.

(*a*) All work must be done in a workmanlike manner to the entire satisfaction of the inspection department having jurisdiction.

(*b*) All material must be rigidly secured in position, and when attached to masonry walls, shall be properly fastened by metal expansion shields or toggle bolts. Wooden plugs will not be acceptable. When deemed necessary to mount fire alarm apparatus upon a back board, such back board must not be less than seven eighths of an inch in thickness, filled with a non-absorptive compound with an air space of at least one quarter of an inch behind the back board for the free circulation of air.

3. Test.

All systems must normally test free of grounds and, upon the completion of the fire alarm system, a satisfactory test of the entire equipment shall be made in the presence of and under the direction of the inspection department having jurisdiction.

4. Accessories.

Automatically operated circuit-breakers and engine stops for shutting down machinery in extremely noisy or hazardous premises may be required, connected with and made a part of the fire alarm system. In no case shall such circuit-breakers or engine stops be installed in such a manner as to cut off the power for lighting or for operating elevators.

5. Central Station System.

A Central Station System in the intent of these rules is one in which when any part of the wiring system except open circuit portion of a ringing circuit is grounded, broken or impaired, so as to prevent the normal operation of the system, a distinctive trouble signal is automatically registered at an approved office of a supervising company.

6. Circuits.

(*a*) Boxes in all cases must be on closed circuits. Signaling devices may be on either open or closed circuits.

(*b*) In all combined open and closed circuit systems, the open or signal portion of the system must be divided into at least two circuits in any one building.

NOTE.—For example, in a six-story building requiring only one sounding device on each floor, those on the first, third and fifth floors must be on one circuit, and those on the second, fourth and sixth floors on the other circuit. When two or more sounding devices are located on any floor, those on each floor must be divided approximately equally between the two circuits.

(*c*) If primary batteries are used to furnish the actuating energy, each open circuit must be operated by an independent battery of approved wet or semi-dry cells or multiples of dry cells.

In combined open and closed circuit systems employing storage batteries to furnish the actuating energy, the gong circuits and box circuits may be operated from the same battery.

(*d*) No circuit in which vibrating bells are connected in multiple shall contain more than eight bells.

No relay shall control more than sixteen vibrating bells or more than two open circuits.

(*e*) When an alarm has been sent in from any one of the alarm boxes, all the sounding devices on the various floors of the building shall automatically sound the number indicating the floor from which the alarm was sent, and shall repeat the signal at least four times.

(*f*) A current indicator shall be provided in every closed circuit except in central station systems.

7. Trouble Signals.

(*a*) An enclosed trouble bell must be provided in connection with each closed circuit to ring continuously in case of weak batteries or an opening of the circuit. The bell, which shall be of an approved design of the vibrating type, must be placed in the engine room or other approved location. At least four cells of open circuit battery of approved make and type must be provided for the bell. The bell and battery shall connect with the contact of a relay having its magnet windings so connected to the circuit that the relay will operate the trouble bell in case of open circuit or weak battery.

(*b*) Systems deriving energy from storage batteries may employ the reserve set of batteries to operate the trouble bell under conditions acceptable to the inspection department having jurisdiction.

8. Maintenance.

The system must be tested every morning at a regular time immediately after the hour of starting work in the building to insure the system and the batteries

being in an operative condition. The test signal shall consist of two taps or blasts. Each alarm box must be operated at least once every month to prove that the mechanism is in perfect working order, in addition to necessary use of boxes in fire drills. All apparatus operated by springs requiring winding shall be rewound after each alarm, and kept in normal condition for operation. A complete record shall be kept of the operation of each system, which shall be subject to examination by the inspection department having jurisdiction.

FIRE ALARM BOXES.

9. General.

There must be one or more fire alarm boxes on each floor of the building. Boxes shall be of an approved type and make, and must be operated by a lever or by breaking glass. Boxes should be so arranged that the alarm shall begin to sound not more than two seconds after the box has been started. Each box must be arranged to send a definite code of signals to indicate the floor or portion of same on which it is located. Not less than three taps or blasts shall be sounded at each revolution of the break wheel. The following suggestion is offered as a guide to assist in the arrangement of the signal code, but it is not to be considered as mandatory:—

Single Building of four floors and basement	1st floor 2-1
	2d floor 2-2
	3d floor 2-3
	4th floor 2-4
	Basement 2-5

10. Timing of Signals.

The timing of signals shall in all cases be such as to distinguish clearly between taps, between digits and between rounds.

11. Design and Construction.

(*a*) There must be a metal case completely enclosing the movement and made dust-proof as far as possible by the use of gaskets or other suitable means. The metal case shall be drilled and tapped to receive standard conduit at top and bottom.

(*b*) All parts of the mechanism must be of the best grade and workmanship. Contact points operated by a break wheel, and contact points on testing devices shall be of commercially pure platinum or silver, and shall be of the scraping type. All contact points must be secured in a substantial manner to phosphor bronze springs, and all current-carrying parts shall be insulated from the mechanism of the box. The break wheel shall be made of suitable non-conducting material, or be suitably insulated and shall not be employed in any manner as an electrical conductor.

Testing device must be of a design which will prevent any unauthorized person from operating the same, and must be so designed as to prevent possibility of box being left inoperative.

(*c*) Lever boxes must be designed to wind automatically when the lever is pulled for an alarm.

Lever box cases must be fitted with a door which can readily be opened, so constructed as to protect the pull lever against accidental injury and on which a handle is rigidly secured. The wording "In case of Fire open Door and pull down Lever as Far as it will go," or equivalent instructions must appear on the door. If used in exposed places, the box shall be enclosed in a suitable weatherproof outer shell.

Approved types of break-glass boxes will be acceptable with no additional protection except where made necessary by weather conditions, and every break-glass type fire alarm box shall be provided with suitable hammer on chain which shall be attached to or near the box, so that the glass can readily be broken. All

break-glass boxes shall have lettered on the fronts the words "Fire Alarm—In case of fire break glass." All boxes requiring glass replacements shall be so arranged that replacement cannot be made until the mechanism is reset for another alarm.

SOUNDING DEVICES.

12. General.

Sounding devices may consist of bells of approved type or other devices acceptable to the inspection department having jurisdiction. There shall be installed on each floor of the building one or more sounding devices sufficient in number and efficiency to be plainly heard throughout the floor above the noise of the machinery and other sounds. Where floors are divided by fire walls, each section may be deemed a separate floor for the purpose of these requirements.

Systems consisting of several types of sounding apparatus should be avoided.

13. Design and Construction.

(*a*) All sounding devices must be of an approved type, and the movement enclosed in a substantially dust-proof metal casing insulated from all current-carrying parts. Where conditions require it, moisture-proof casings must be provided. Sounding devices shall be placed with their lowest parts about eight feet from the floor. Wherever there is danger of mechanical injury, the entire device shall be enclosed in a protecting case made of approved wire netting or perforated metal.

(*b*) Gongs must be made of a high grade of cast bell metal, or other approved material, and shall be, except by special permission, not less than eight inches in diameter.

(*c*) Adjustments must be of such a character that they can be securely locked in position in an approved manner.

(*d*) Contact points must be ample in area, not only to take care of current used in operation, but to insure long life, and shall be of commercially pure silver, platinum, carbon, or other approved material.

(*e*) Hammer rods must be protected against mechanical injury or derangement by the use of a guard or other suitable means.

14. Horns and Whistles.

When conditions in a factory building make the use of fire alarm horns necessary, they may be required and shall be installed in a manner acceptable to the inspection department having jurisdiction. Horn field and armature windings shall be of a resistance value suitable for the voltage employed.

Electrically controlled whistles may be required as auxiliary equipment, and shall be installed in a manner acceptable to the inspection department having jurisdiction.

RELAYS.

15. Design and Installation.

(*a*) All relays must be mounted in such a position that gravity will assist the action of the armature retracting spring and be enclosed in an approved metal case under lock and key and located where there is no danger of sparking contacts igniting inflammable gases or flyings.

(*b*) Relays must be mounted where they will be least affected by vibration in building, and in no case shall they be mounted on the same backboard with sounding apparatus, or so that they will be affected by the vibration caused by such sounding apparatus, and shall be plainly marked with the maximum and minimum operating current values to which such relays will safely respond.

WIRING.

16. Wiring.

(*a*) All conductors must be run in approved metallic conduits or armored cable installed as follows: Conduits and armored cables, when not terminated in drilled and tapped fittings, shall be rigidly secured to all fittings by approved locknuts and bushing. Conduits shall be not less than ½-inch internal diameter where not more than four conductors are used, and where a greater number of conductors is used, the internal diameter of the conduit shall be at least 3/16 of an inch larger than the outside diameter of the bunched wire it is to accommodate.

Fire alarm conduits shall not contain any foreign wires whatever.

(*b*) All wires must be rubber covered and braided, and comply with requirements of the National Electrical Code. Wiring in all systems shall be installed, and conduits and armored cables shall be permanently and effectually grounded as prescribed by the National Electrical Code.

(*c*) No conductor of less than No. 14 B. & S. gauge not having a rubber insulation wall less than 3/64 of an inch in thickness will be approved except that for central station systems and for multiple conductor cables of three or more wires. No. 16 B. & S. gauge wires with rubber insulation 1/32 of an inch in thickness may be used.

(*d*) Where wires pass from one building to another, they must be enclosed in rigid conduit underground between buildings wherever possible, and when so installed must be lead encased.

(*e*) Wires between buildings when not run in conduit must be at least equivalent in conductivity and tensile strength to No. 12 B. & S. copper for box and signaling circuits. They must be supported at least every 75 feet on approved glass insulators and brackets. As far as possible, they should be run under rather than over electric light or power wires.

SOURCES OF ELECTRICAL ENERGY.

The following sources of energy may be employed:—

1. Storage batteries in duplicate.
2. Electric Light or Power system (Public Service or isolated plant) supplemented by storage batteries controlled by automatic throw over device.

NOTE.—By special permission of the inspection department having jurisdiction the storage batteries may be omitted.

3. Primary batteries in duplicate.

17. Storage Batteries.

(*a*) Storage batteries may be employed if under competent supervision and equipped with reliable charging and controlling devices.

(*b*) Storage batteries must be of approved make and type. Each set must be capable of maintaining the system efficiently for seven days without recharging.

(*c*) A sufficient number of storage cells must be provided in battery to secure thoroughly satisfactory operation, the required number in each installation to be designated by the inspection department having jurisdiction.

(*d*) Storage batteries must be installed in an approved manner in properly ventilated protecting cabinets and, wherever possible, must be placed in a room not containing other fire alarm apparatus. If these batteries are placed in a separate room with proper ventilation, and where they will not be subject to mechanical injury, protecting cabinets will not be required.

(*e*) The batteries must not be disconnected from the fire alarm system during working hours in the factory.

(*f*) A full description of the operation of each system, together with instructions for its proper care and maintenance, must be posted in a conspicuous place and in a substantial manner, accessible to the person in charge of the system.

(*g*) It is preferable that the voltage of the charging circuit be not over 250 volts.

(*h*) Suitable provision must be made on a switchboard for charging the batteries, with approved means of protecting them against injury due to interruption of charging current; also provision for shifting the respective batteries from charging to working and from working to charging without opening any of the working circuits during the process of shifting.

Fixed resistance units (of approved type and design) must be provided, one in each leg of the charging circuit of such a value as operating conditions may warrant, but in no case shall the charging rate be in excess of two thirds of the normal charging rate of the storage cells unless a variable charging rate is required.

One third of the total resistance to be used shall be fixed in each leg of the charging circuit, and the balance provided with an approved shifting device for varying the charging rate, the minimum resistance to be such that the batteries cannot be charged in excess of their normal charging rate. Resistance in any case must not unduly heat.

Lamps will not be permitted for resistance.

Fuses 50 per cent in excess of normal load and not in excess of allowable carrying capacities of wire must be provided at battery terminals and on all working circuits. All fuses must be of the enclosed type.

(*i*) Motor generators of suitable capacity and standard design may be used for charging storage batteries, and when used must be installed in accordance with the National Electrical Code rules, and a proper field regulator must be provided in addition to regular switchboard equipment referred to above, except that resistance in charging circuits will not be required.

(*j*) When alternating current is used with equipment for charging storage batteries, approved motor generators or rectifying sets with necessary transformer must be provided, together with regular switchboard equipment above specified.

18. Electric Light and Power (Public Service or Isolated Plant), Supplemented by Storage Batteries.

Systems of this character are special, and complete details of installation must be submitted for approval in each case to the inspection department having jurisdiction, which may, by special permission, authorize the omission of the supplementary storage batteries.

19. Primary Batteries.

(*a*) The battery on the closed circuit must be in duplicate and be provided with an approved single pole, double throw, knife blade switch, so arranged that when changing from one set of batteries to another the circuit cannot be broken, and shall consist of approved standard closed circuit cells of not less than 300-ampere hours capacity. Approved heat-resisting glass jars are preferred, but at least one glass jar shall be used in each series for the purpose of observing the condition of the elements. The working voltage of approved closed circuit cells is .65 volts per cell. Dry cells shall not be used to supply actuating energy in any closed circuit, except in central station systems.

(*b*) The battery on the open circuits shall consist of high grade open circuit, wet or semi-dry cells of approved type and make. A reserve set of batteries must be provided and chemicals furnished with them in a dry state, and as any set becomes exhausted they shall immediately be prepared for service. Multiples of dry cells in approved containers may be substituted for wet or semi-dry cells in each open or bell circuit under conditions acceptable to the inspection department having jurisdiction. A sufficient number of cells must be provided in each battery to secure thoroughly satisfactory operation.

(*c*) The current flow from any primary battery shall not exceed 2 amperes.

(*d*) All batteries must be coupled together by means of battery connectors of approved type.

(*e*) All primary batteries must be placed in substantial well-fitted cabinets, elevated not less than six inches and not more than six feet above the floor and located in a clean, dry place where the temperature will not fall below 40 degrees Fahr. nor rise above 100 degees Fahr.

(*f*) Cabinets must be provided with shelves of wood not less than ⅞-inch in thickness or of other approved material, properly fastened and secured to prevent sagging.

Supports for dry batteries must be so constructed that it will be impossible for the cells to come in contact with each other or with the metal enclosures.

Main battery cabinets must be so constructed that the condition of the elements may be observed without disturbing the cells.

(*g*) Metal cabinets must be of approved type, constructed of sheet iron or steel of not less than No. 14 U. S. metal gauge.

Doors must be provided with lock and key and kept closed.

The interior and the exterior of metal cabinets must be painted with two coats of asphaltum compound, each coat to be thoroughly dried before the next is applied. Baked enamel will be accepted in lieu of the above.

(*h*) Wooden battery cabinets must be constructed of the best grade of kiln dried wood not less than ⅞-inch thick. Doors must be provided with a padlock and kept closed.

Wooden cabinets must be painted on the interior with two coats of asphaltum compound and on the exterior with two coats of lead paint, varnish or asphaltum compound.

AUTOMATIC EQUIPMENT.

20. Special Permission Required.

Approved automátic fire alarm devices and thermostat systems arranged automatically to set in motion transmitting devices in connection with the manual fire alarm systems covered by the foregoing rules, may be allowed by special permission of the inspection department having jurisdiction.

Report of Fire Tests of Nitro-cellulose Motion Picture Films in Various Types of Containers to Determine Proper Size of Pressure Relief Vent Opening.

Prepared for QUARTERLY by F. J. T. Stewart.*

Summary

These tests were conducted by a special committee of the Committee on Explosives and Combustibles of the National Fire Protection Association. Especial mention should be made of the valuable co-operation and assistance rendered by a conference committee representing a large portion of the film industry, of which Mr. William Sistrom of the Universal Film Manufacturing Co. acted as Chairman. Valuable assistance was also rendered by the Bureau of Supplies and Repairs of the New York Fire Department, C. S. Demarest, Chief. Joseph O. Hammitt, Chief of the Fire Prevention Bureau of the Fire Department, also co-operated. The Philadelphia Fire Underwriters' Association, through its Secretary, Mr. C. A. Hexamer, who is also Chairman of the Committee on Explosives and Combustibles, donated the test cabinet and otherwise rendered valuable assistance. Representatives of the National Board of Fire Underwriters also co-operated. Mr. J. S. Macgregor, Director of the Testing Laboratory Columbia University, had charge of the pyrometers used in the vault tests. Mr. A. E. Ewen, Engineer of the New York Board of Fire Underwriters, prepared the detailed plans and specifications for the tests under the direction of the Chairman of the Special Committee.

The Rules for the Storage and Handling of Nitro-cellulose Motion Picture Films as recommended by the Committee on Explosives and Combustibles of the National Fire Protection Association provide for vaults, safes and cabinets as suitable containers for the storage of films under certain restrictions. In view of the rapid rate of combustion of such films when ignited, it was considered important to ascertain by tests on a large scale the size of the vent opening necessary to prevent the accumulation of dangerous pressure within the vault. As the result of an investigation conducted in 1910 under the auspices of the U. S.

*Chairman Special Committee in charge of tests.

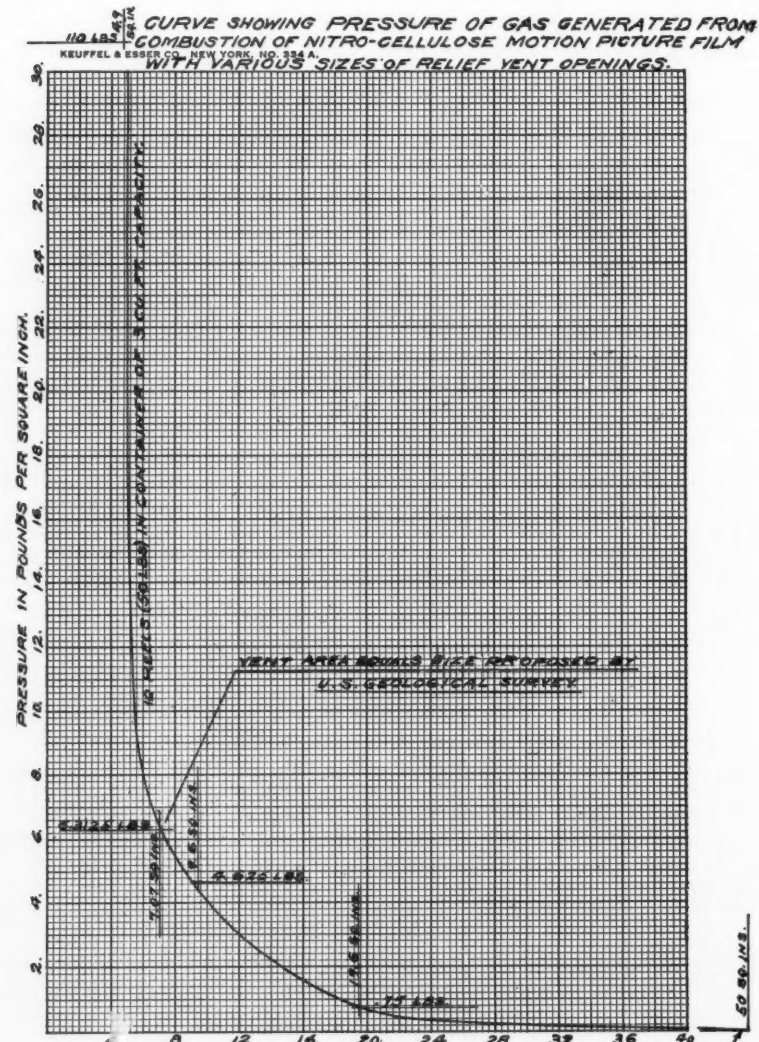
Geological Survey, a vent area of 70 square inches for each 100 reels (500 pounds of film) was suggested as essential. This result was based on calculations made after tests on a small scale, and it was considered desirable, both by the Committee on Explosives and Combustibles and the Conference Committee of the Film Industry, to make tests on a larger scale to verify this conclusion.

Before undertaking the test of a considerable quantity of film in a vault, it was decided to conduct preliminary tests on a somewhat larger scale than heretofore to verify the area of vent opening which had been suggested. A container of 3 cubic feet capacity was accordingly constructed and series of tests were conducted. These tests indicated that a vent area of 70 square inches for 100 reels (500 pounds of film) was sufficient to prevent excessive pressure as long as the films were separately enclosed in metal cans and special precautions were taken to prevent any obstruction from reducing the effective area of the vent opening. Tests with reels not separately enclosed in metal cans indicated that the area of the vent suggested was dangerously close to the critical point beyond which the pressure increased abnormally for any further reduction in the vent area. (See Figure 3.)

Based on the conclusions reached from the preliminary tests a vault containing 1,900 pounds of film (the equivalent of a little less than 400 reels) was tested with a vent area about six per cent in excess of 70 square inches for each 100 reels. The vent area in the vault test was nearly in proportion to that used for Test No. 11 as given in the table under Preliminary Tests, Plate 2. The results checked approximately, the pressure being somewhat less in the vault test than that obtained in the test of the small container. A matter of serious concern from the viewpoint of exposure to other property was the shaft of intensely hot flame, 73 feet long, which issued from the vent opening of the vault.

To determine the advisability of permitting the storage of 50 reels of film (250 pounds) in light metal cabinets, a double-compartment cabinet was tested. Each compartment was designed for a capacity of 40 reels. The area of the vent opening was about 88 per cent in excess of 70 square inches for each 100 reels. The test indicated that cabinets carefully constructed in full conformity with the specifications recommended by the committee and containing not more than 50 reels may safely be permitted, if individual cabinets are separated at least a few feet from each other and from all combustible materials. The test also indicated the importance of having the vent pipes from the cabinets run independently of each other to the outside of the building.

As the result of the above tests the following specifications for pressure relief vent openings in motion picture film storage containers are recommended:—


CURVE SHOWING PRESSURE OF GAS GENERATED FROM COMBUSTION OF NITRO-CELLULOSE MOTION PICTURE FILM WITH VARIOUS SIZES OF RELIEF VENT OPENINGS.
KEUFFEL & ESSER CO. NEW YORK. NO. 334 A.
110 LBS.
PRESSURE IN POUNDS PER SQUARE INCH.
30. 28. 26. 24. 22. 20. 18. 16. 14. 12. 10. 8. 6. 4. 2.
12 REELS (58 LBS.) IN CONTAINER OF 3 CU. FT. CAPACITY.
VENT AREA REQUIRED BY RULE PROPOSED BY U.S. GEOLOGICAL SURVEY.
8.6 SQ. INS.
8.626 LBS.
7.07 SQ. INS.
2.5 SQ. INS.
7.5 LBS.
8. 12. 16. 20. 24. 28. 32. 36. 40
VENT AREA IN SQUARE INCHES.
0 LBS.
50 SQ. INS.

NATIONAL FIRE PROTECTION ASS'N. FIG. 3.

Pressure Relief for Vaults, Safes and Cabinets.

Each container for film storage shall be provided with a pressure relief vent opening to the outside of the building, directly through an exterior wall, or through a separate stack with walls of reinforced concrete or brick at least 5 inches thick and shielded at top. The effective sectional area of the opening shall be at least 70 square inches for each 100 reels (500 pounds) of film capacity. The capacity of vaults shall be rated at three reels per foot of cubical contents (see Plate 3); the capacity of safes and cabinets, or small vaults without aisle space, shall be rated at six reels per foot of cubical contents. Reels shall not be placed near enough to vent opening to reduce its effective area. A permanent guard shall be installed to prevent films from being forced against the vent openings of small containers. In fireproof buildings horizontal ducts may be permitted to connect the relief openings in vault separately to the outside of the building, provided the walls are made of solid masonry at least five inches thick and securely supported. A riveted sheet metal pipe of at least No. 18 U. S. gauge in thickness may be permitted to separately connect the vent opening of each cabinet to the outside of the building, provided the pipe is covered with at least one inch of approved heat insulating material. Such pipes shall not be nearer than nine inches to combustible material.

Each pressure relief vent shall be protected against the weather by thin glass (1/16-inch thick) painted a dark color or by other incombustible fragile material in a sash arranged to open automatically in case of fire by the use of a fusible link or thermostat placed inside the film container. The effective sectional area of the vent opening shall correspond with the actual area of the glass. No pane of glass to be smaller than 200 square inches. Muntins to be constructed as lightly as possible so as to break readily.

A light wire screen, not coarser than ⅛-inch mesh, shall also be placed over each vent at a point between the glass sash and the container, so arranged as not to interfere with the automatic operation of the sash.

The outlet of each vent shall be located at a point above the roof. Exception will be made only where a different location of the outlet will not expose other property in the same or adjacent buildings, and then only by special permission of the inspection department having jurisdiction.

Preliminary Tests.

These tests were held on March 11 and 16, 1915, in an open lot adjoining the Bureau of Repairs and Supplies of the New York Fire Department.

The object of the test was to obtain information indicating the relation between size of vent opening in film containers and the pressure therein resulting from the combustion of the film. Reference to Figure 3, illustrating graphically the results of the preliminary tests on films without individual containers, will show from the shape of the curve that it is vitally important to have the vent area of ample size to prevent the pressure from approximating the critical point. If this is not done, a slight

obstruction which may reduce the effective area of the vent would result in a rapid increase in the pressure, which would most likely cause the container to explode with considerable violence and likewise permit gases to be generated under a pressure which renders them particularly liable to explosion when mixed with air. The vent area of 7.07 square inches for 10 reels used in one of the tests recorded in Plate 2, represented the critical point below which the U. S. Geological Survey suggested it was dangerous to reduce the area of the vent. The shape of the curve shown in Figure 3 indicates that this ratio represents practically the critical point as regards naked film. For films in separate containers there is some margin of safety with this vent area, as will be indicated by a comparison of Tests No. 4 and No. 11 contained in the Table, Plate 2. The pressures are not exactly comparable, as there were 62 pounds of film in Test No. 11 and only 50 pounds in Test No. 4.

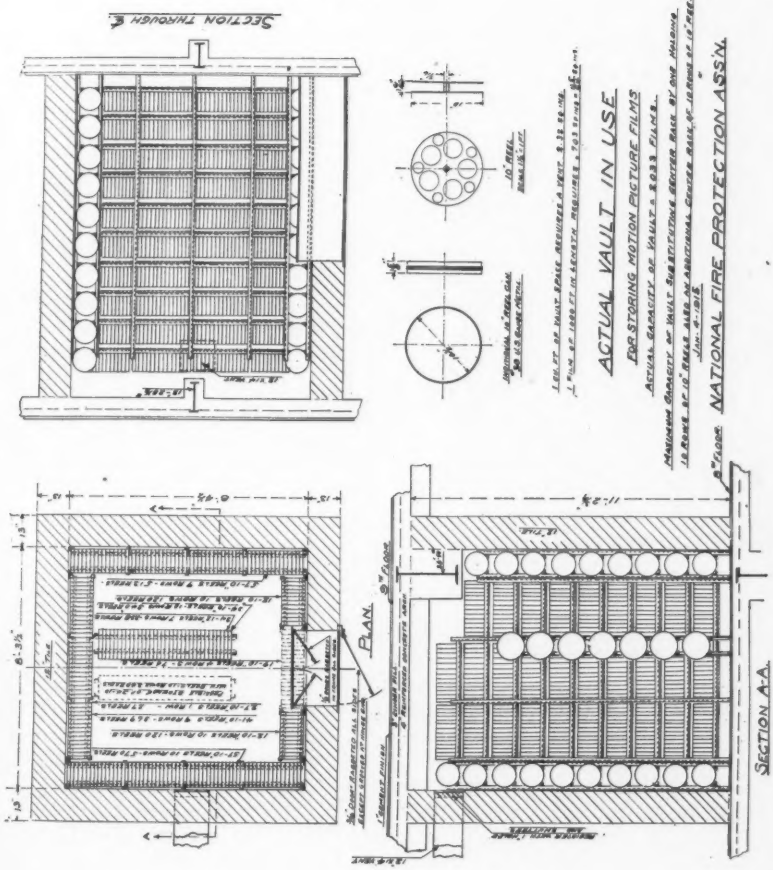
NATIONAL FIRE PROTECTION ASSOCIATION.

RECORD OF PRELIMINARY TEST OF INFLAMMABLE MOTION PICTURE FILM.

TEST NO.	SIZE OF RELIEF VENT.	AMOUNT OF FILM USED.	APPROXIMATE DURATION OF COMBUSTION.	PRESSURE INSIDE CONTAINER.	REMARKS.
1.	10 1/8" DIA. 84.5 SQ. INS.	10 NAKED REELS 50 LBS.	NOT TAKEN.	NONE.	CONTINUOUS CLEAR FLAME OF CONSIDERABLE MAGNITUDE, NO SMOKE.
2.	8" DIA. 50.26 SQ. INS.	" "	1 MIN.	NONE	" " " " " " " "
3.	5" DIA. 19.6 SQ. INS.	" "	1 MIN.	1/2 LB. INNER. 1 LB. OUTER.	" " " " " " " "
4	3 1/2" DIA. 9.6 SQ. INS.	" "	1 MIN. 3 SEC.	5 1/2 LBS. INNER. 3 1/2 LBS. OUTER	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE.
5	5" DIA. 7.07 SQ. INS.	" "	NOT TAKEN.	7 LBS. (6 1/2 LBS. 7 LBS. 6 1/2 LBS.) INNER. OUTER.	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE. A FEW PIECES OF FILM WERE BLOWN OUT THROUGH VENT HOLE A DISTANCE ABOUT 100 FT.
6.	2 1/2" DIA. 4.9 SQ. INS.	" "	NOT TAKEN.	ABOVE 10 LBS.	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE. NUMEROUS PIECES OF FILM WERE BLOWN OUT THROUGH VENT HOLE A DISTANCE ABOUT 120 FT. THE NO. 12 PLATE, WITH RELIEF VENT HOLE, WAS BADLY BULGED.
7	5" DIA. 7.07 SQ. INS	20 NAKED REELS 100 LBS.	NOT TAKEN	OVER 300 LBS. FOR A MINUTE THEN BURST WITHOUT	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE. NUMEROUS PIECES OF FILM WERE BLOWN OUT THROUGH VENT HOLE A DISTANCE ABOUT 150 FT. THE NO. 12 PLATE, WITH RELIEF VENT HOLE, WAS BADLY BULGED ALSO SPACER WAS BENT.
8	3 1/2" DIA. 9.6 SQ. INS.	" "	1 MIN. 9 SEC.	6 LBS. INNER. 7 1/2-8 LBS. OUTER.	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE. A FEW PIECES OF FILM WERE BLOWN OUT THROUGH VENT HOLE A DISTANCE ABOUT 50 FT AND IGNITED.
9	3" DIA. 7.07 SQ. INS. (12 HOLES DRILLED OVER OPENING)	10 NAKED REELS 50 LBS.	NOT TAKEN	25 + 10 LBS. INNER 25 + 15 LBS. OUTER	COMBUSTION WAS WITHOUT FLAME, HEAVY WHITE SMOKE. THE LOWER PRESSURE OCCURED AFTER SCREEN WAS BLOWN OUT.
10	3 1/2" DIA. 9.6 SQ. INS.	25 LBS. IN SEPARATE CANS 10 LBS. FOR TORCH.	NOT TAKEN.	NOT TAKEN.	THE 10 LBS. OF NAKED FILM USED AS TORCH WAS PLACED AT RELIEF VENT END OF CONTAINER AND BURNED OUT WITHOUT IGNITING FILM IN CANS.
11.	3 1/2" DIA. 9.6 SQ. INS.	50 LBS. IN SEPARATE CANS 12 LBS. FOR TORCH.	30 MIN. 45 SEC.	13 LB. INNER. 2 LBS. OUTER.	OUTER FLANGE OF CONTAINER HAD NOT TIGHTENED PROPERLY. FILM WAS IGNITED PREMATURELY. ALL COVERS OF CANS WERE OFF WHEN CONTAINER WAS CLEANED EXCEPT ONE. ALL FILM WAS CONSUMED.
12.	5" DIA. 7.07 SQ. INS.	50 LBS. IN SEPARATE CANS 12 LBS FOR TORCH.	NOT TAKEN.	5 LBS INNER. 5 LBS OUTER	THE T SPACER USED TO PREVENT VENT HOLE BECOMING CLOSED) HAD NOT PLACED IN CONTAINER AND CANS PARTIALLY BLOCKED VENT OPENING.

NOTES. TESTS 1-2-4-8-10-11-12 MADE MARCH 11, 1915. 3-5-6-7-9 MADE MARCH 16, 1915.
INNER GAUGE WAS CONNECTED 6 INCHES FROM BLANK END OF PIPE. OUTER GAUGE WAS CONNECTED 6 INCHES FROM RELIEF VENT OPENING.
SEE USE TESTS.
AFTER EACH TEST CONTAINER WAS COOLED BY WATER.
NAKED FILM INDICATES FILM NOT IN CANS.
PRESSURE DID NOT START TO RISE UNTIL THE HEAVY WHITE SMOKE BEGAN TO ISSUE FROM RELIEF VENT OPENING.
WHEN FILM WAS IN CANS ABOVE 10 OR 12 LBS. OF LOOSE FILM WAS USED AS A TORCH WHICH, WHEN IGNITED, BURNED WITH A BRIGHT FLAME. THIS FLAME SUBSIDED FOR ABOUT 3 SECONDS WHEN THE FILM IN CANS IGNITED, BURNING SIMILAR TO NAKED FILM.
TEST NO. 10 SHOWS VALUE OF CANS TO PROTECT FILM FROM A FLAME OF VERY SHORT DURATION AS FILM DID NOT BURN ALTHOUGH CANS NEAREST VENT END OF CONTAINER WERE SLIGHTLY BLACKENED.
12 LBS. WAS HIGHEST READING TAKEN IN TEST NO 6 AND IT IS PROBABLE PRESSURE ROSE HIGHER.
IN TEST NO. 7 PRESSURE ROSE GRADUALLY TO 50 LBS. THEN SUDDENLY TO OVER 300 LBS. (GAUGES READ TO 300 LBS. ONLY) WHERE IT REMAINED FOR AN INSTANT ONLY, RETURNING TO 50 LBS WHERE IT REMAINED STEADY TO END OF TEST.
IN TESTS NOS. 6-7-12 THE HIGHEST PRESSURES APPARENTLY WERE DUE TO PARTIAL OBSTRUCTION TO RELIEF VENT OPENING BY PIECES OF FILM.

PLATE NO. 2.


ACTUAL VAULT IN USE
FOR STORING MOTION PICTURE FILMS
NATIONAL FIRE PROTECTION ASS'N.
PLATE NO 3.
SECTION THROUGH E
PLAN.
SECTION A-A.

Description of container: The apparatus used was a container of 3 cubic feet capacity made of 12-inch standard wrought-iron pipe, 3 feet 10 inches long (Plate 1 and Figure 1). One end was closed by a blank

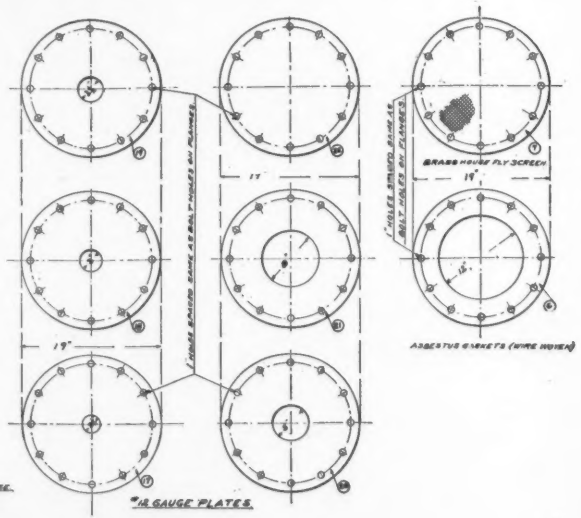
Fig. 1.

General View of Container Used in the Preliminary Test.

cap. A standard flange was screwed on the other end. In order to obtain the different sizes of vent area desired in this experiment, several No. 12 sheet steel plates with holes in the center of sizes varying from 8 inches diameter (50.26 square inches) to 2½ inches diameter (4.9 square inches) were made to fit between this flange and an outer flange having an inside diameter of 10⅜ inches. For the purpose of keeping the film away from the vent opening a spacer was provided consisting of 1 x ¼ inch bars with legs 7 inches long, the ends of which rested against the shoulder formed by the outer flange. In order to read the pressure generated in the container, 50 and 300 pound gauges were connected to the container 6 inches from each end. The film was ignited by means of a spark plug, tapped in the side of the container which lighted a fuse soaked with gasoline.

LIST OF MATERIAL.

LIST NO.	NO. OF PARTS	NAME.	FURNISHED BY
1	1	12" WROUGHT PIPE 5'-10" LONG, THREADED AT ENDS AND TO HAVE TWO ⅜" IRON HOLES TAPPED 6" FROM ENDS.	N.Y. BD. OF FIRE UNDRTS
2	1	12" CAST IRON CAP.	" " " "
3	1	12" X 15" STANDARD FLANGE.	" " " "
4	1	10" X 15" STANDARD REDUCING FLANGE.	" " " "
5	12	⅞" x 3¾" BOLTS & NUTS.	N.Y. FIRE DEPT.
6	2	⅛" - 19" x 12" ASBESTOS GASKETS (WIRE WOVEN) WITH 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
7	2	19" WIRE BRASS HOUSE FLY SCREENS WITH 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
8	2	½" COMMON BRASS OR IRON SIPHONS.	" " " "
9	4	½" BRASS OR IRON LOCK NUTS	" " " "
10	4	½" x ½" x ½" BRASS OR IRON TEES.	" " " "
11	2	½" x ½" BRASS ELLS.	NAT'L. BD. OF FIRE UND
12	2	½" TEE HANDLE, SINGLE MALE THREAD, CORK.	" " " "
13	2	½" " " DOUBLE FEMALE " "	" " " "
14	6	½" IRON NIPPLES 2" LONG.	N.Y. FIRE DEPT.
15	2	200 LB. GAUGES.	NAT'L. BD. OF FIRE UND
16	2	50 LB. "	" " " "
17	1	12 GAUGE 19" DIAM. PLATE WITH 2½" DIAM. HOLE AT CENTRE & 1" HOLES SPACED SAME AS HOLES ON FLANGES.	N.Y. FIRE DEPT.
18	1	12 GAUGE 19" DIAM. PLATE WITH 3" DIAM. HOLE AT CENTRE & 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
19	1	12 GAUGE 19" DIAM. PLATE WITH 4" DIAM. HOLE AT CENTRE & 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
20	1	12 GAUGE 19" DIAM. PLATE WITH 5" DIAM. HOLE AT CENTRE & 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
21	1	12 GAUGE 19" DIAM. PLATE WITH 9" DIAM. HOLE AT CENTRE & 1" HOLES SPACED SAME AS HOLES ON FLANGES.	" " " "
22	1	12 GAUGE 19" DIAM. PLATE WITH 1" HOLES SPACED SAME AS BOLT HOLES AT FLANGES.	" " " "
23	2	3"x1" BARS ABOUT 2'0" LONG AND BENT WITH 7" LEG AND DRILLED IN CENTRE 6" APART CENTRE TO ⅝" STOVE BOLTS	" " " "
24	1	1'x1'x¼" PLATE DRILLED IN CENTRE FOR ⅝" STOVE BOLT	" " " "
25	2	¼ STOVE BOLTS 1" LONG & NUTS.	" " " "



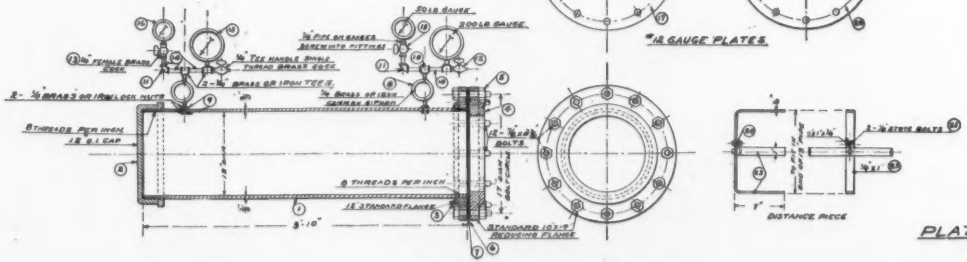

200 LB GAUGE
50 LB GAUGE
½" TEE HANDLE SINGLE THREAD BRASS CORK
½" FEMALE BRASS CORK
½" BRASS OR IRON GASKET & NUTS
2 - ½" BRASS OR IRON LOCK NUTS
8 THREADS PER INCH
12 G.I. CAP
8 THREADS PER INCH
12 STANDARD FLANGE
5'-10"
STANDARD 10 X 15 REDUCING FLANGE
12 - ⅞" x 3¾" BOLTS
2 - ⅝" STOVE BOLTS
DISTANCE PIECE

PLATE NO. 1

Method of conducting tests: In each test the films were weighed, placed on edge and packed tightly against each other in the container. The 7-inch spacer, described above, was then inserted to prevent the film clogging the vent opening. A No. 12 gauge plate with vent hole was placed in position and the outer flange bolted on. The film was ignited by a spark plug and gasoline fuse, as stated. After each test the container was cooled by water from a hose line attached to a street hydrant.

As it was uncertain what pressure would be developed, it was considered advisable to make a trial test, using a small amount of film with the largest vent opening. This test showed no pressure and was not recorded. Then tests with different sizes of vent openings and different quantities of film were made. (Plate No. 2.) A photograph illustrating discharge of dense smoke from vent opening during one of the tests is shown in Figure 2.

Fig. 2.

View Showing Dense Smoke Without Flame which Issued from the Vent Opening of Container in Preliminary Tests when Pressure Exceeded Five Pounds.

Result of tests: The results of these tests are summarized in convenient form in the Table accompanying this report (Plate 2). The data on the series of tests, using ten naked reels in each case with different sizes of vent openings, is shown graphically in Figure No. 3.

With large vent areas and small pressures, an intensely hot, clear flame was noted outside the vent opening. With smaller vent areas and correspondingly increased pressure (above five pounds), the flame disappeared and a dense white smoke was discharged from the vent opening. In practically all of the experiments where any appreciable pressure developed, pieces of the film from one to six feet long were forced out from the vent opening by the pressure within the container. In some cases the pieces of film were blown a distance of 120 feet and it was necessary to use a hose stream in order to extinguish the burning film thus scattered about the premises.

In Test No. 9 a screen was placed over the vent opening. This immediately became clogged with a gummy substance which closed the openings in the screen and created a pressure of approximately twenty-five pounds before the screen blew out. On account of the excessive pressure which might be produced by the clogging of a substantial screen, it is evidently essential that the screen should be of light, frail construction so as to break readily when the pressure begins to accumulate. A light wire screen such as fly screen is desirable to use as a protection against outside exposures, such as fire brands. In the case of stacks discharging vertically, it is essential that a weather shield or hood should be placed above the stack, using perhaps a fine screen inside the outlet from the stack, or at the point where it connects with the film container.

Vault test.

This test was held on April 22, 1915, in a large open lot at the new plant of the Universal Film Manufacturing Co. at Leonia Heights, N. J.

The object of this test was to confirm on a larger scale the results obtained from preliminary tests, with particular reference to the proper size of pressure relief vent opening. It was felt advisable to use a vent area of 285 square inches for 1,900 pounds of film, or approximately 6 per cent in excess of 70 square inches per 100 reels, the size suggested by the investigators of the U. S. Geological Survey. When the test was about half over, this area was unintentionally increased to 396 square inches (48 per cent in excess of the Geological Survey figure), due to the fact that the sash for the glass window was forced out.

As most of the films were enclosed separately in metal containers, the rate of burning was somewhat less than for the tests shown graphically by the curve in Figure 3. No. 11 in the table of the preliminary tests, Plate 2, represents a test of 62 pounds of film in a container with a vent area somewhat smaller in proportion than that used in the vault test. In Test No. 11 most of the films were likewise in separate containers and the average pressure recorded was 1¾ pounds. Taking into consideration the relative difference in the vent areas in proportion to the number of films, the corresponding pressure to be expected in the vault would be somewhat over 1½ pounds. The actual results indicated approximately one half pound pressure in the vault. While the two tests do not check exactly, they may be regarded as an approximate check after making

Fig. 4.

General View of Test Vault.

Film capacity about one ton—400 reels.

allowance for possible errors. Owing to the small scale on which the preliminary tests were conducted, it is probable that minor obstructions may have influenced the effective area of the vent opening. In any case, the two tests are considered to check sufficiently for practical purposes and seem to confirm the opinion of the experts of the U. S. Geological Survey to the effect that it is dangerous to consider a vent area less than 70 square inches for each 100 reels of film (500 pounds). It is preferable that even a larger vent area should be used, especially if nitro-cellulose films or similar material should ever be stored in a vault without small metal containers such as are used for each film, as these metal containers reduce in a degree the rate of combustion and accordingly the pressure.

Perhaps the most serious feature to safeguard in connection with a fire in films stored in a vault is the serious exposure to neighboring property resulting from the intensely hot projected flame, which in this test was over 70 feet long and 8 feet in diameter after it issued from the relief vent opening. (See Figure 7.) Such a flame would impinge upon buildings across a 60-foot street. The shaft of flame was so hot that the heat radiated within 25 feet on each side would endanger com-

bustible materials. The length of the flame and the severity of the heat would undoubtedly be greater for a full-size vault, which is a little less than six times larger than the test vault. It will therefore be seen that the installation of these vaults in congested parts of large cities involves a serious exposure hazard, even across comparatively wide streets, if the outlet of the relief vent discharges horizontally. If it discharges vertically, the burning film which may be blown out will be likely to endanger neighboring property.

Description of vault: The vault was constructed in accordance with the specifications of the National Board of Fire Underwriters dated 1910 (Plate 4, Figure 4). The walls were made of 12-inch hollow tile laid on

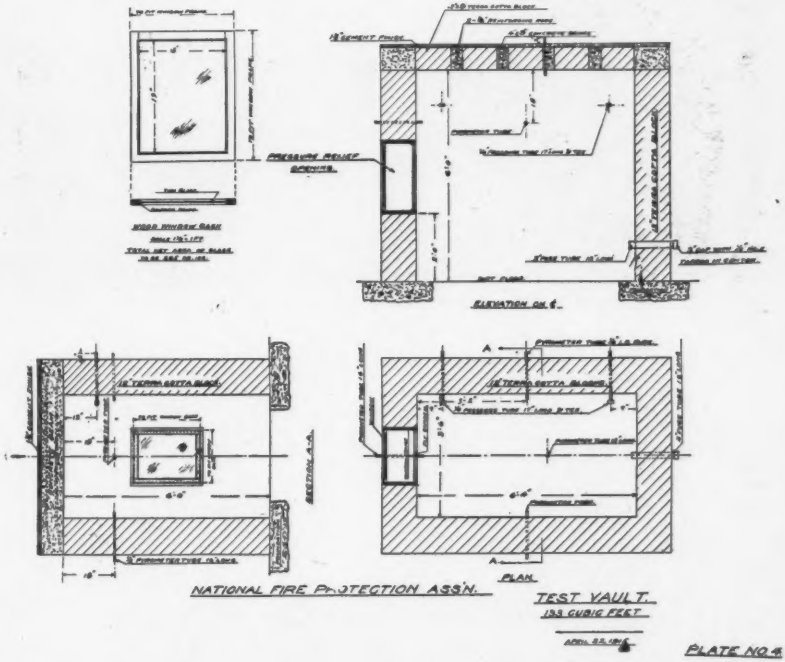


PLATE NO. 4

end in Portland cement mortar, on a concrete foundation. The interior dimensions of the vault were 6 feet 4 inches long, 3 feet 6 inches wide and 6 feet high, aggregating 133 cubic feet capacity. The roof construction was a combination of reinforced concrete and hollow tile consisting of 4 x 9 inch concrete beams reinforced with ¾-inch rods 1 inch from top and bottom; the spaces between beams were filled with 9-inch hollow tile. A concrete cap the width of side walls and thickness of the roof, formed the corner between the roof and side walls. The entire top

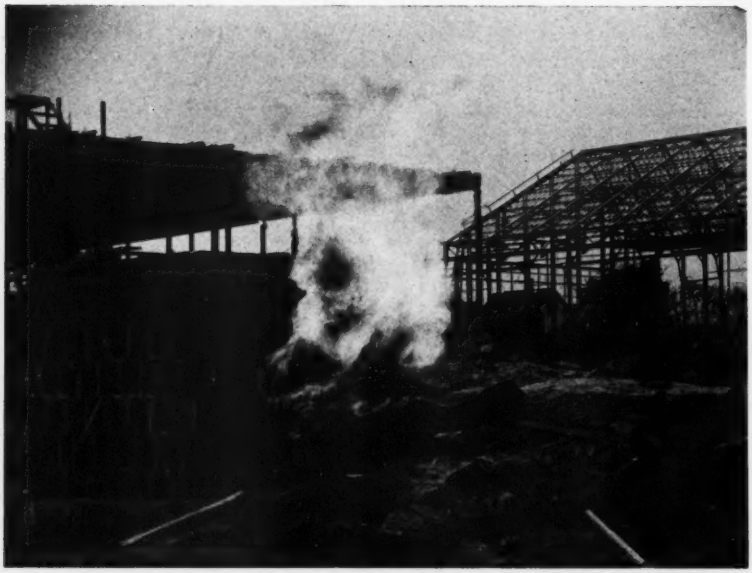


Fig. 5.

First Burst of Flame Issuing from Pressure Relief Opening Directly After Glass Window Blew Out.

was covered by a 1½-inch cement finish. There was no reinforcing or tie other than the bond of cement attaching the roof to the side walls. The floor was of earth.

The only opening to the test vault was a pressure relief vent 18 x 22 inches. As all vent openings should be protected in some manner against weather and fire brands, a No. 12 mesh screen (fly screen) was placed on a wooden frame at the inside face of the vent opening to approximate a completely equipped vault; also a thin glass in wooden sash window with a total glass area of 285 square inches was placed at the outside face of the vent opening.

In order to read the pressure generated in the vault, gauges were attached at the end of two ¼-inch pipes 30 feet long. The pipes were placed in south side wall of vault, 12 inches down from roof and 9 inches from each end, and terminated with a ¼-inch tee projecting about 3 inches inside of inner surface of the wall.

Three pyrometer couples were installed to measure the temperatures in the vault; one located in center of roof and one on each side wall about 12 inches down from roof.

The films were placed on racks made of iron bars, supported by angle iron uprights located along sides of vault (none at ends).

A 2-inch diameter pipe was located near the bottom at the blank end of vault, to be used as a fuse tube. The film was ignited by a gasoline soaked fuse which in turn was ignited from a spark plug tapped in a cap, screwed on the outside end of the fuse pipe.

Method of conducting test: Film was weighed and placed in the vault as follows: 1,490 pounds of film in rolls (each roll being in separate metal container) were placed on edge on the racks, while a total of 250 pounds of naked film in rolls was placed between groups of containers; also 160 pounds of loose film in three burlap bags were laid on the floor to act as a torch. There were in all 1,900 pounds of film in the vault.

After the pyrometer couples were properly installed, the fly screen was nailed in place at the inside face of the pressure relief opening; then the thin glass window was nailed in place at the outside face of the opening.

The film was ignited by a spark plug and gasoline soaked fuse, as previously noted.

Result of test: Three seconds after the film was ignited the glass blew out. (See Figure 5.) Between 10 and 15 seconds after the film

Fig. 6.

Flame Just Before It Reached Its Maximum Volume and Intensity.

was ignited the wire screen blew out, which reduced the pressure from 4 ounces to zero. At about 105 seconds after the film was ignited, one of the burlap bags was blown out through the pressure relief opening to a distance of 50 feet, taking with it the screen frame and the thin glass window sash. This increased the area of the vent opening from 285 to 396 square inches. The maximum pressure of 8 ounces was attained before the bag was blown out, and probably the increase in area of pressure relief opening had but little if any effect on the maximum pressure. (See Figure 6.)

A shaft of intensely hot flame about 70 feet long and 8 feet in diameter issued from the relief vent opening of the vault. It began about 30 seconds after the film was ignited and lasted about 90 seconds (Figure 7). The gases which issued from the pressure relief opening of the vault were bluish in color, changing to a light yellow flame about one foot from the opening. This flame was sufficiently hot to spall rocks about ¼ to ½ inch deep which were in its path. The heat from the flame was unbearable 30 feet distant at the sides.

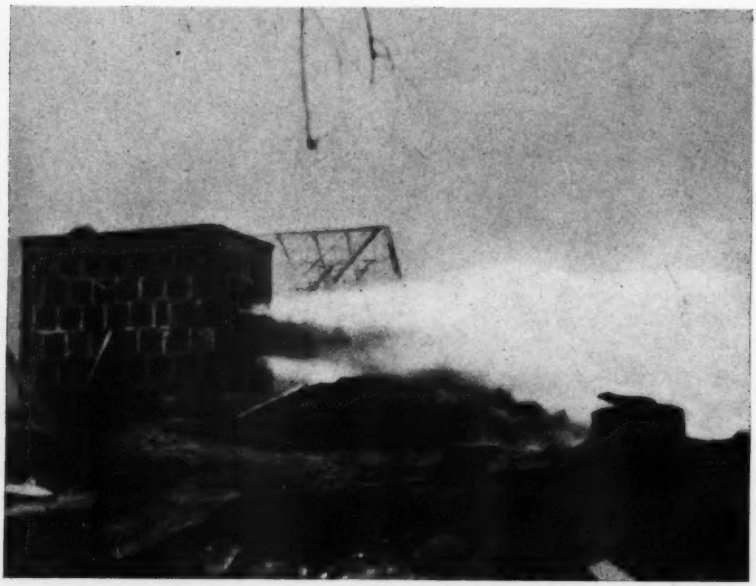


Fig. 7.

Flame at Its Maximum Volume and Intensity.

This flame extended horizontally from pressure relief opening, a distance of 73 feet, and was 8 feet in diameter.

Record of Pressure Inside Vault.

Time Seconds.	Pressure in oz.	Time Seconds.	Pressure in oz.	Time Seconds.	Pressure in oz.
5	0	65	4	125	4
10	4	70	4	130	0
15	0	75	4	135	0
20	0	80	4	140	0
25	0	85	8	145	0
30	2	90	8	150	0
35	2	95	8	155	0
40	2	100	8	160	0
45	4	105	8	165	0
50	4	110	8	170	0
55	4	115	8	175	0
60	4	120	4	180	0

Log of Temperature Readings of Fire Test upon Motion Picture Film Vault.

Time. Seconds.	Temperature Degrees Fahrenheit. Couple No. 1.	Couple No. 2.	Couple No. 4.
6	605	....	325
17	685	....	....
37	....	....	585
45	....	875	....
60	875	....	....
70	....	....	987
80	....	1087	....
90	1120	....	....
95	....	....	1050
105	....	1120	....
115	1120	....	....
120	....	....	1035
145	1035	....	....

NOTE.—Couples No. 1, 2 and 3 were located as follows: No. 1 middle of roof; No. 2 middle of south wall, and No. 3 middle of north wall.

The temperature of the exterior flame was not taken, but it is estimated to have been at least 1,700 degrees.

Cabinet Test.

This test was held April 22, 1915, at the same time and place as the film vault test. The object of the test was to obtain information to indicate whether the proposed specifications to permit the storage of not exceeding 50 reels in such cabinets were justified. To gain information respecting the exposure of one cabinet to another in close proximity, a double cabinet with a partition was used in the test. The vent ducts from each cabinet were joined together a short distance above their connections with the cabinets. The doors were so hinged that both opened from the center of the double cabinet. The test indicated that the cabinet construction was reasonably satisfactory for the purpose intended, but fire

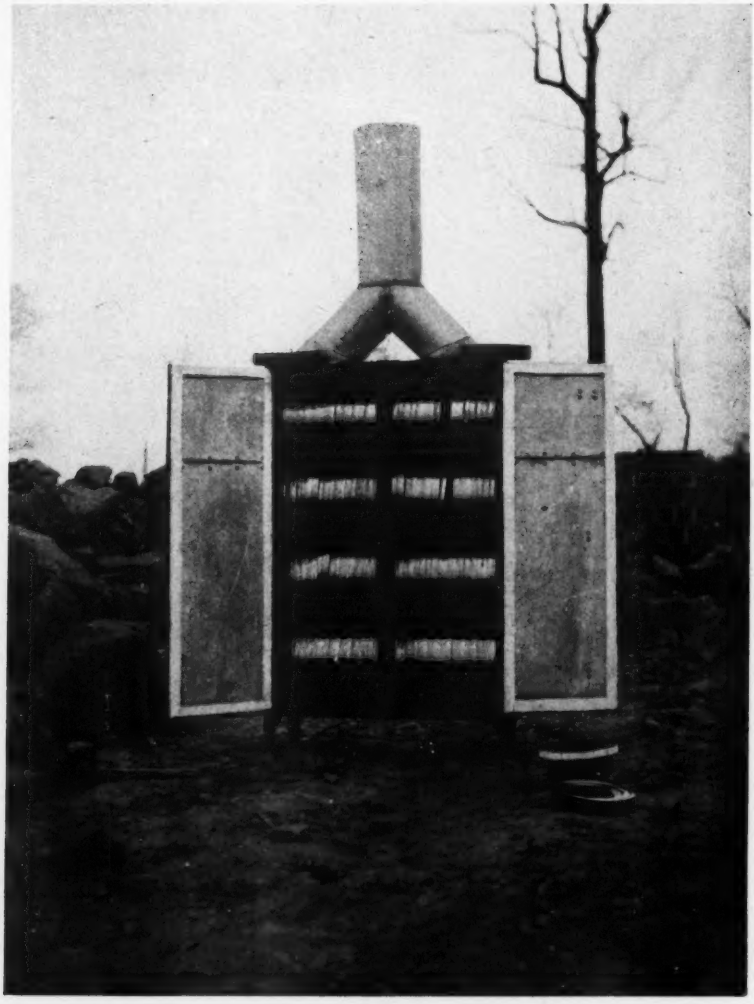
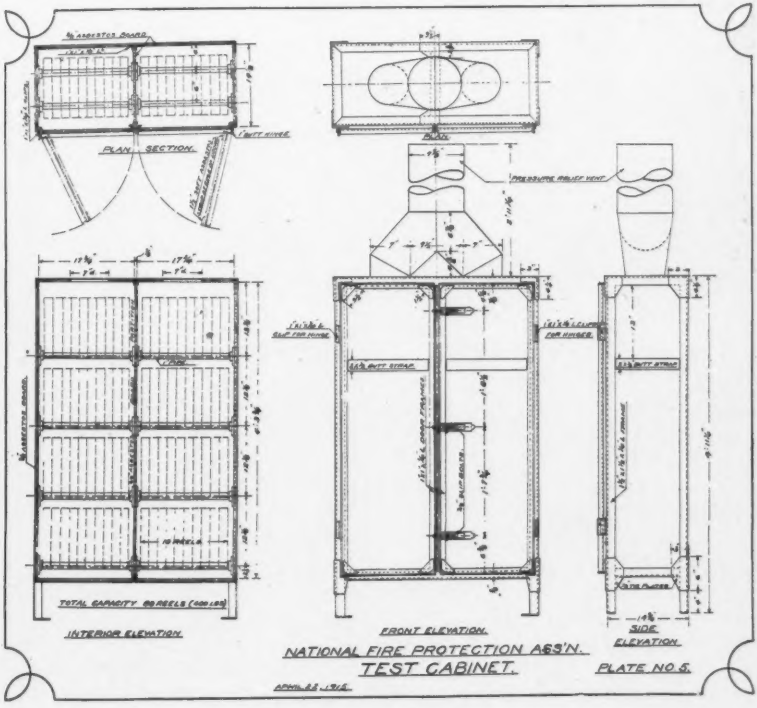


Fig. 8.

Front View of Cabinet With Doors Open Before Test.

was communicated from one cabinet to the other, showing that there should be some space between adjacent cabinets as provided for in the specifications. While there was some doubt as to the exact manner in which the fire communicated from one cabinet to the other, it was evident that it would undoubtedly communicate through the vent pipes which

converged within 6½ inches of the cabinets. It is apparently essential that each vent pipe should be separately carried to the outside of the building and arranged to have the outlets some distance apart. The amount of heat developed, and the flame which issued at small cracks, particularly around the doors, indicated the importance of having single cabinets well away from combustible material, and of enclosing them in a separate room when more than one cabinet is used. The size of the pressure relief vent opening for each cabinet was 88 per cent in excess of that suggested by the U. S. Geological Survey, and while the long, hot flame was discharged at considerable pressure from the outlet of the vent pipe, the character of the flame indicated that the pressure was small, probably less than one half pound.



Description of cabinet: The cabinet was constructed of two compartments designed to hold 40 reels of film (200 pounds) in each compartment. The interior dimensions being 1 foot 5¾ inches wide, 14⅛ inches deep and 4 feet 3¾ inches high (Plate 5). The walls of the cabinet, also the interior partition dividing the compartments were constructed of asbestos board ⅜ of an inch thick, in 1½ x 1½ x ¼ inch angle iron frame. The asbestos board was fastened to the frame by ¼-inch bolts, the angle iron frame being riveted at corners. The interior partition

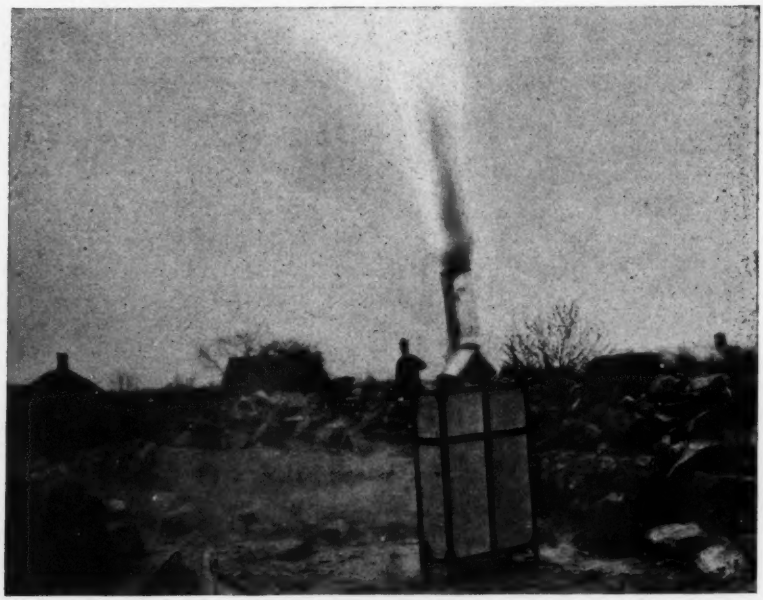


Fig. 9.

View of Cabinet Showing Flame Discharging from Vent Pipe About Twelve Feet High.

was held by a double 1 x 1 x ¼ inch angle. Two doors, one to each compartment, were constructed of similar material to the body of the cabinet in a 1 x 1 x ¼ inch angle iron frame. Near the inside edges of the doors was a soft asbestos strip 1½ inches wide, for the purpose of insuring a tight joint between the frame and the doors when closed. Each door had two 3 x 1 inch butt hinges, which were fastened to a small angle iron on the cabinet frame. The doors when closed were fastened by three slip bolts about equally spaced from top to bottom on one door which slipped through holes in a 1½ x 1½ x ⅛ inch T bar between the doors; also in holes in the angle iron frame of the other door.

The racks for holding the film were made of one-inch pipe set in sockets at sides of cabinet and bolted to the asbestos board with ¼-inch bolts. The pressure relief vent was through a hole 7 inches diameter (38.48 square inches) in the top of each compartment. A sheet metal pipe about No. 18 U. S. gauge was connected to the vent opening of each compartment and joined into one pipe 9⅞ inches in diameter (76.6 square inches), which is equal to the total area of the two 7-inch pipes. The shortest distance from the pressure relief opening of each compartment to the point where the pipes converged into one common pipe was about 6½ inches.

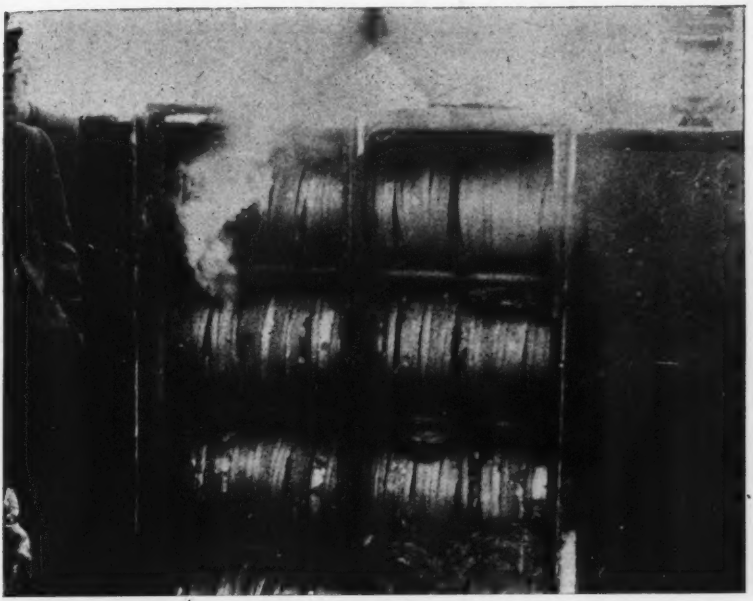


Fig. 10.
Front View of Cabinet with Door Open After Test.

Method of conducting test: The film was weighed and placed on edge on the racks in the cabinet (Figure 8). The latter was designed to hold 40 full reels (200 pounds) to each compartment, but as each reel did not weigh the average of 5 pounds, a total of 290 pounds was all that could be stored in the cabinet. Of this total all films except about 50 pounds were in separate metal containers.

Result of test: The film was ignited in one compartment by a match used to light a piece of film which extended outside between the door and the cabinet frame at the bottom. Immediately thereafter smoke, followed by flame, shot up through the vent pipe about 12 feet. (Figure 9.) About 25 seconds after one compartment was lighted the films in the other compartment ignited. A small flame issued from the edges of the door of the first compartment and it is uncertain whether ignition in the second compartment was due to the flame issuing around the door or through the vent pipe described above or heat transmitted through the dividing partition. The entire length of time the flame issued from the vent pipe was about 3 minutes. After the test the walls were very hot. A large percentage of the containers were found open. (See Figure 10.) There was no provision made for taking pressures and temperatures in this test.

Foundries—Their Processes and Hazards.

This paper contains a brief description of the processes usually found in foundries, together with a study of the fire hazards of each process, and suggestions for safeguarding such hazards. Besides the principal hazards found in all foundries, several which frequently appear, but which are not necessarily limited to such properties, will be considered.

Outline of Processes.

The products of a foundry are called castings, whether made from iron, steel or an alloy. These castings are made by heating the desired metal until it becomes a liquid, when it is poured into a mould and allowed to solidify. On cooling, the hot liquid assumes the shape of the interior of this mould. The simplest castings are medallions or cameos, which are made by pouring the molten metal over a one-sided open mould until a casting of the required thickness is obtained. Next in order may be considered solid castings such as statues, flatirons and similar things, where the exterior form is completely governed by interior walls of a hollow mould. More complicated castings which have hollow spaces, as bells, pipes, pieces of machinery, etc., require complex moulds in order to secure the proper result.

Nearly all foundries also have rooms for the storage, grinding and sifting of sand and the storage of coke, iron, fuel oil and other materials; pickling rooms, cleaning, tumbling and chipping rooms. It is necessary to have a place for the storage of patterns and also moulds, while a carpenter shop is almost a necessity in order to make moulds and repair patterns, even if a complete pattern shop is not maintained.

Buildings.

It is a general practice to make foundries only one story in height, with pitched roof and monitors. The size and quality of the buildings vary from a small frame structure to a modern steel and concrete building with several thousand feet of floor space. Some of the most efficient foundries have two floor levels, an upper floor where the moulding and casting is done and a basement floor where all the materials are stored and into which finished castings and sand from the dumped moulds may be dropped. It is not unusual to find a small foundry, particularly one casting alloys, on the upper floors of a factory building several stories in height. This condition is more liable to be found in small foundries located in the center of large cities.

Processes in Detail.

The principal processes found in a foundry may be roughly grouped as follows: (1) making of patterns and flasks; (2) preparation of the mould, including core making; (3) melting and reduction of metal used to a proper fluidity; (4) pouring the molten metal into the mould, and any other work while it is cooling and solidifying; (5) cleaning and finishing the castings.

1. **Manufacture of Patterns and Flasks.** The majority of patterns are made of wood. The pattern is usually painted black and may be shellacked. Portions which are taken up by cores in the mould are generally painted red to distinguish them from the remainder of the patterns. Patterns which are used frequently are often made of metal, generally brass. A great deal of care should be exercised in the storage of patterns, since a comparatively small number may represent a large valuation. The habit of storing valuable patterns in old sheds or other poor buildings is to be condemned. Master patterns should be stored in a fireproof vault. Other valuable patterns should be placed, if possible, in fireproof buildings and in small groups, so that a fire starting in one group could be extinguished before spreading over the whole supply. The light wooden construction of patterns makes them unusually good fuel for a fire.

Small and medium sized castings are usually made in moulds, which in turn are made in a framework called a flask. Some of the smaller flasks may be made of iron, but the larger ones are nearly always made of wood. The manufacture and repair of patterns and flasks is an ordinary process of a woodworking or metal-working shop, and will not be covered in this paper.

2. **Preparing the Mould.** Moulds are made of various substances, as metal, stone, clay, plaster of Paris, loam or sand. Small articles made from metals having a low melting point are usually cast in metal moulds. Printing type and bullets are examples of castings made from metal moulds. Brass ingots are examples of castings of stone moulds, which are often made of granite, and in the case of easily fusible metals plaster of Paris is used for moulds. However, metals which have a high melting point are almost always cast in moulds of sand and loam. This is the type of mould used in iron and steel castings, and the kind to be considered in this article. The room for the preparation of such moulds usually occupies a good part of the floor space of a foundry. It is more often the practice to have this work done on the ground floor of the foundry, in which case the floor itself is generally earth and composed to a depth of several inches of moulding sand. In the case of some of the larger plants where this work is done on the second floor, it is made of concrete or some equally suitable material. Foundries making heavy castings have large cranes to lift and move about the flasks, moulds and castings. The method employed in making small and large castings with the same metal differs somewhat. Very large castings usually have the

mould built in large excavations in the foundry floor, in which case the mould is built up of fire brick suitably braced and supported. The smaller castings are made in moulds contained in flasks to simplify handling. The sand from which the mould is made has to be selected with great care. It is necessary to have sand which will make a smooth and well-defined cavity and will at the same time have sufficient porosity to allow the escape of air and gases which are generated during the pouring of the metal.

Hollow articles are often cast in moulds, and this is a comparatively simple process. The mould is made in the usual manner from a solid pattern. In the meantime a core which is shaped like the hollow part of the article has been made. This core is manufactured from sand and some binding material or paste, and is baked in an oven until it becomes hard and is free from moisture. The core is located in the mould in such a position that when the metal is poured it flows about the core. After cooling, the core is easily broken out, thus leaving a hollow casting. Cores are baked in ovens heated with hard coal, fuel oil or gas.

Foundries which make a great many castings from one pattern often use moulding machines. These machines are usually operated by compressed air, and save a great deal of time in raising the pattern from the mould and also insure a more uniform product. Before pouring it is necessary to remove all excessive moisture from the mould. This is often done by the use of temporary furnaces or by large fuel oil torches.

3(*a*). **Melting the Metal (Iron).** The furnace for melting the iron is generally placed at a central location in the foundry, usually the center of one side of the building. This furnace may be of the air type or more often it is a blast furnace known as a cupola. Anthracite coal may be used, although coke is the most common fuel. Wood charcoal is the best material, since it is free from sulphur. The furnace depends for its draft upon the ascending column of air in the chimney. In the cupola a current of air is forced into the bottom by a blowing machine, through tubes called tuyeres. Cupolas are made of boiler iron in the form of a cylinder and are lined with fire-brick and clay. They vary from three to seven feet in diameter and are several feet high. The capacity of melted metal also varies from three or four tons per hour to several times this amount. The chimney is usually made of boiler iron lined with fire-brick.

A cupola is charged by placing a quantity of kindling wood upon the floor and above this a layer of anthracite coal or coke in sufficient quantity to fill the cupola to a height of several inches above the entrance of the tuyeres after the contents has settled and the wood has burned away. A layer of pig iron is placed upon this layer of fuel, and then successive layers of fuel and iron. Where necessary a flux consisting of powdered marble or limestone may be added. The wood is usually ignited and this in turn ignites the coal or coke. In some foundries the wood is not necessary, as the coke is ignited directly by a large portable torch using fuel oil under pressure.

3(*b*). **Melting Metal (Brass).** Metal for large castings is usually

melted in a reverberatory furnace, which may be described as a furnace with a dome so arranged that it reflects the flame upon a vessel placed within it and thus surrounds it with heat. The fuel generally used is charcoal. Cupolas are very seldom used for melting brass. If only a small quantity is desired, black lead crucibles are often used. These are heated in a furnace placed beneath a platform raised a few feet above or depressed a few feet into the floor for convenience in handling. The melting point of brass is 1,600 to 1,800 degrees Fahrenheit. The copper is usually melted first, then the zinc is added. Anthracite coal or coke is used for heating the crucible, and the surface of the alloy is covered with charcoal, which is consumed and adds to the heat, at the same time preventing oxidation. The other processes for brass casting are practically the same as for iron casting.

4. **Pouring.** As soon as the metal has been melted it is poured into the mould. This pouring is done from iron pots of various sizes lined with clay, which are called ladles. These ladles vary greatly in form and size, the smaller ones being handled by one man, while the very large ones require powerful cranes. When a sufficient quantity of metal in the cupola has attained a proper degree of fluidity, the clay stopper or plug is removed and the molten metal is caught in the ladles which are placed under the spout. In the smaller foundries this pouring usually takes place in the afternoon, while in the larger foundries, which have a continuous run of product, the pouring is carried on throughout the day. Small articles may be taken from the flasks very soon after they are poured, while the larger ones must be left several hours before they become thoroughly cool.

5. **Cleaning and Finishing.** As soon as the rough castings are taken from a flask the sand is rubbed from them and then they are carried to the cleaning department. Here the hard scale and clinging sand is usually removed by treating the castings to a bath of sulphuric or hydrofluoric acid. Emery wheels, burnishers and pneumatic chisels are used to remove small metal projections. Many foundries also have a polishing, painting, lacquering and japanning department.

Hazards.

1. **Preparing the Mould.** The principal hazard under this heading is that of drying out the mould. This may be done with temporary stoves or furnaces placed directly in the mould, or with heat flues so arranged that the heat may be conducted to the interior surface of the mould, or by portable fuel oil torches or other similar means. Excess moisture must be removed from the sand or else when the hot metal enters the mould it will form steam which, in expanding, would endanger the mould and might even cause an explosion if there were a very large amount of moisture present. The fire record of foundries, however, does not show that this operation has been a source of any appreciable number of fires.

2. **Core Ovens.** Core ovens are usually constructed of brick and are heated by either hard coal fires, fuel oil or gas, whichever may be most convenient. The fire record shows that 15.3 per cent of foundry fires are traceable to the core oven. Nearly all of these fires could have been prevented by exercising a few simple precautions. Although woodwork has no place in a well-designed foundry, it is nevertheless found in a great many of them. Special effort should be made to remove any woodwork which may be near these core ovens or their flues. If this cannot be done, the woodwork should be completely covered with sheet metal or, better still, wire lath and plaster and Portland cement, or some asbestos covering. A flue or oven too hot to be touched by the hand is dangerous. Where the metal stack passes through the roof it should be protected by a metal thimble with an air space or some other equivalent, so as to prevent any possible heat from the flue igniting the wooden roof. Lumber or flasks should never be placed on top of core ovens. Care should be taken that core ovens are always kept in good repair and any cracks immediately filled with cement. Where possible, it is advisable to have the core ovens outside the building, having only the door opening into the foundry.

3. **Melting Metal.** Forty-two and seven-tenths per cent of foundry fires reported were caused by the cupola, the larger number of them by sparks from cupola. The remedy for such fires is a simple one: (1) All roofs within possible range of sparks from the cupola should be covered with non-inflammable material; (2) cupola should be equipped with a hood or other device which would prevent sparks from being showered over the neighboring roofs; (3) all unprotected inflammable material should be removed from proximity to cupola walls. Where fireproof roofs are not used they should be covered with metal with no exposed wood ventilators, frames or skylights. Special precaution should be taken to prevent the roof igniting at the point where the cupola stack passes through it. Charging floors for cupolas should be of non-combustible material, as iron, brick or concrete. There is considerable danger of fire when the cupola is dumped, and a hand hose should always be placed nearby for such emergency. The brass furnace does not present as serious a hazard as the iron furnace. It should not, however, be in proximity to woodwork, and never be used in rooms which do not have fireproof floors. At present brass foundries are frequently found in other than one-story buildings having the foundry floor of combustible material.

4. **Pouring.** Before molten metal is allowed to run into the ladles it is necessary to warm and remove the moisture from the ladle. This is usually done by kindling a small wood fire in it, although in some of the more modern foundries this is accomplished by the use of a large torch and a portable fuel oil tank outfit. In either case this does not present any appreciable hazard if carefully done in a clear space in the foundry. Very frequently when the castings are poured the hot iron ignites the wooden flasks. Such fires are readily extinguished generally by throwing sand on them. Again, the hot metal may be spilled on the floor or accidentally come in contact with combustible material if there should be any

in the construction of the foundry. The advisability of keeping all combustible material out of foundry buildings is obvious. If this is done there is very small probability of a fire starting from the handling of hot metal. There have been one or two instances in which fires were caused by an explosion of the mould at the time of pouring. This may be considered an unusual incident, probably due to excessive moisture. Many fires have been caused from hot smouldering flasks. As soon as the sand and castings have been removed from the flasks they should be placed either in an outside yard, away from buildings, or at some point where there is no possibility of their igniting buildings in case a spark lingers in them and is fanned into flame. Special precaution should be taken that wooden flasks are never put in storage in a building until several hours have elapsed since their use, to absolutely insure that there are no live sparks. Iron flasks do not present this hazard, and the only danger of fire from them, which is quite remote, is when they are placed hot against some combustible wall.

5. **Cleaning and Finishing.** The general processes of cleaning the castings are practically free from fire dangers. Projections and gates are removed from castings either by hand or compressed air power chippers. An acid bath is frequently used to clean the castings and remove any clinging sand and slag. Care should be exercised in the storage of these acids, which are usually sulphuric or hydrofluoric.

Tumbling is also a non-hazardous cleaning process accomplished by placing the castings in a slow revolving cylinder or receptacle where they become burnished by rubbing together. Coarse emery wheels are generally used to grind off projections and smooth up rough places. Emery wheel dust, if wet, may heat and ignite spontaneously. Burnishing, buffing and polishing are done with rag wheels. The principal hazards here are those due to hot bearings, spontaneous combustion, or sparks from the dust. A good collector system with metal blower pipes discharging into a fireproof receptacle is advisable. Lint should not be allowed to collect in the room and the receptacle should be frequently cleaned.

General. Many establishments which are primarily foundries carry on some other process in conjunction with the foundry work, and it is necessary to consider this feature in the proper study of the fire hazards of such a plant. Piping and pipe fittings are frequently dipped in asphaltum or tar to protect them from corrosion. This process should be carried on in a detached building, as fires have been caused by heating the pipes too hot so that the tar was ignited when they were dipped into the bath. Painting, lacquering and japanning are other special processes which are occasionally found in connection with foundries. Their hazards will not be considered in detail here other than to advise that this work be carried on in a separate building particularly constructed for the purpose. The increasing use of fuel oil for heating core ovens and small portable torches for numerous other purposes has introduced an appreciable hazard into foundries. This material should be stored in an approved manner,

and special precautions should be taken to see that all piping, tanks, etc., are maintained in good condition and free from leaks. It is advisable to have piping so arranged that in case of emergency the supply can be readily shut off at the source, and the piping drained.

Sprinkler Protection. It was at one time thought that automatic sprinklers were not suitable for use in foundries on account of the supposed danger of water being discharged on molten metal. Experience has shown, however, that this does not present any danger whatever and that automatic sprinklers can be used just as advantageously in foundries as in other properties. The fire record of foundries indicates that sprinklers have been very efficient when installed in such properties, and that if the system is properly laid out there is very small chance of a fire reaching serious proportions. Sprinklers are particularly effective in foundries because of the fact that a great many of the fires occur in the night after smouldering for several hours. These fires might not be discovered until they had made considerable headway. An automatic sprinkler system will promptly check any such fires and at the same time announce their discovery if an alarm system is included in the equipment.

Department of Fire Record.

Foundries—Fire Record.

This record is made up from the fire reports received by the Association since October, 1906, and includes foundries making all kinds of castings such as iron, steel, brass, etc. Although there is considerable difference in these materials and in the details of making castings from them, the essential processes and hazards are very much the same, and therefore it seems quite proper to include all kinds of foundries in the same fire record.

One of the most interesting things brought out in the compilation of this record is that a large number of fires in foundries are caused by hazards not usually associated with such properties; that is, some other work on a small scale is carried on in the foundry in connection with the regular business. Two examples will illustrate this: (1) five fires were caused by dipping hot iron pipes (a product of the foundry) in asphaltum or tar in order to make them less liable to rust; (2) in another large plant a fire started in a kitchen which was part of the restaurant where the employees obtained their lunches.

A study of the causes of foundry fires immediately brings out the fact that the cupola is still the most prolific cause, for 30.7 per cent of fires from known causes originated here, and nearly all these fires could have been prevented by such simple precautions as removing combustible material from the vicinity of the cupola, using only non-combustible roof coverings, and equipping the cupola with a hood or other device to prevent sparks from being showered over the neighborhood. Next to the cupola the core oven is the most frequent cause of fire. This hazard also could be almost entirely eliminated by giving careful attention to the construction of core ovens and their surroundings. Among the most frequent common causes are locomotive sparks and heating. The former is in part explained by the fact that many large plants have their own locomotives which enter various buildings, while the latter is no doubt largely due to the habit of constructing a rough office with a carelessly installed stove in the foundry proper for the use of the foreman or superintendent.

Sixty-two and seven-tenths per cent of all foundry fires occurred at

night, and for this reason they may smoulder for several hours unless a watchman is present to detect the fire. Thirty-two and nine-tenths per cent of all foundry fires were discovered by the watchman, which is a very good record. It is doubtful if there is any industry in which a watchman has better opportunities to prevent loss by fire than in a foundry, and consequently great care should be used to select a suitable man for this position.

An examination of the record of automatic sprinklers in this class of property indicates that they have been very successful, for there were only 2.5 per cent classed as unsatisfactory and only 3.8 per cent of fires in buildings equipped with automatic sprinklers resulted in large losses.

In conclusion it may be said that most of the fires in foundries can be prevented by the proper safeguarding of heating devices. Also, the use of combustible material should be avoided as far as practicable. If this is done and an automatic sprinkler system is installed, there should be very small chance of a serious fire.

Foundries—Fire Record.

Total Number of Fires Reported, 475.*

1. CLASSIFICATION OF CAUSES.

Summary.

Common Causes.

	No. of Fires.	Per Cent of Common Causes.	Per Cent of Known Causes.
Heating	16	18.6	4.4
Lighting	12	14.0	3.3
Power	9	10.5	2.5
Lightning	4	4.6	1.1
Boiler (or fuel)	9	10.5	2.5
Oily Material	5	5.8	1.4
Rubbish (or sweepings)	3	3.5	0.8
Locomotive Sparks	19	22.1	5.1
Smoking	4	4.6	1.1
Miscellaneous	5	5.8	1.4
Total	86	100.0	

*Includes data from Fire Patrol Reports which was not sufficiently complete to use in all the tables.

Special Hazard Causes.

	No. of Fires.	Per Cent of Special Hazards.	Per Cent of Known Causes.
Cupola	112	42.7	30.7
Sparks from	87		
Heat from	14		
Miscellaneous	11		
Core Oven	40	15.3	11.0
Moulding, Pouring and Casting	34	13.0	9.3
Furnaces	25	9.5	6.9
Hot Castings	8	3.0	2.2
Slag	1	0.4	0.3
Flasks	7	2.7	1.9
Fuel Oil	8	3.0	2.2
Dip Tank	2	0.8	0.6
Charcoal	2	0.8	0.6
Asphaltum or Tar Dipping of Pipes	5	1.9	1.4
Phosphorus	3	1.2	0.8
Miscellaneous	15	5.7	4.1
Total	262	100.0	
Common Causes	86	23.6	
Special Hazard Causes	262	72.0	
Incendiary	8	2.2	
Exposure	8	2.2	
Total Known Causes	364	100.0	
Unknown Causes	111		
Total	475		

Details of Causes.

Under this heading are given brief descriptions of fires caused by unusual conditions, or which are of an educational value in emphasizing different hazards. Fires caused by ordinary conditions or well understood hazards may not be included.

SPECIAL HAZARDS.

Core Ovens.

S-12921. Cores were baked by a continuous process, being passed through a brick oven heated by fuel oil. One of the burners had become clogged and after it had been repaired and the oil turned on there was apparently not sufficient air to properly burn it. A flare-back occurred which communicated to the galvanized iron flue running along the front of furnace. There was evidently an accumulation of soot in this flue which took fire. Fire was controlled by chemical extinguishers used by employees.

H-9424. Overheated core oven set fire to joists and roof boards directly in front of oven and a few feet above.

S-15393. There were two core ovens built of iron, brick and cement, about eight feet square. Both of these ovens were heated by crude oil with air blast. The whole system was well arranged, but apparently something went wrong with the oil burner, for the pit was filled with oil, and this became ignited. The whole air in this locality seemed full of fire. Fire was extinguished by the public fire department with three hose streams, while five sprinklers in the pattern room adjoining opened and prevented the spread of fire in this direction.

S-14574. A one-story building of frame construction adjoined the main foundry building, without cut-offs, and contained brick core ovens (seven in number and about eight feet in height) which opened into the foundry, but were fired with coke from the rear in core-oven building. There was a corrugated iron hood without any vent over the front of the core ovens and the top of this hood was suspended from top of parapetted iron wall of core ovens. The heat from coke fires under these ovens passed through the floor of the oven, which consisted of metal plates bored full of holes and circulated down again to combustion chamber, thence up well-arranged brick flue to brick chimney. When doors to core ovens were opened, large quantities of heat were released, also vapor of the core oil, and this condensed on the iron hood and also on the timbers of the pitched roof to the foundry. This oil under the hood took fire when one of the core ovens

was opened and immediately extended to the roof timbers. It is stated that the sprinklers opened almost immediately and were a decided factor in preventing a serious fire. The private fire brigade quickly brought into use two lines of hose and completed the extinguishment of the blaze.

H-5739. Soot from burning coke and coal oil had accumulated on underside of roof, which was only two feet above core oven. This material was ignited by heat from oven.

H-5371. Fire was apparently caused by a heavy coating or deposit on vent pipe from ovens catching fire and spreading to the enclosed monitor through which the vent pipe passed. The heat of the ovens in drying the cores, which are mixed with a molasses compound, drives off a heavy smoke which caused a black sticky deposit to form on the vent or stack.

Furnaces.

S-14119. Fire was caused by two small breaks in the side of open hearth furnace, allowing molten metal to flow out among some core boxes. These furnaces were constructed of brick and held together by iron rods, and had all iron and steel charging floors.

H-4404. Forty-two-inch riveted steel pipes are used to convey the air blast at twenty pounds pressure from the engines to the furnaces. After a period of time the interior of pipes become more or less coated with cylinder oil, gradually deposited by the air from the engines. Fires ordinarily start at the furnace and return to the engines against the air current, making the large pipes red hot their entire lengths to the engines, where the elbows and turns seem to contain the most oily deposit, so that a great deal of heat is radiated at this point, often setting fire to surrounding woodwork. A collection of oily dust on top of pipes further aids in the spread of fire. This seemed to have been the cause here. The one-inch roof boards near the eaves, about six to eight feet above pipes, took fire, from where the flames spread rapidly, consuming the roof over the five engines and a portion of the roof over the dynamo room.

H-4203. Fire started in an old wooden sill which was completely buried underground behind a battery of brass furnaces. There were ten inches of fire brick and cement between the fire and the sill. Fire had evidently been smouldering for several days, as furnaces had not been used for two days before the fire. It spread up the walls into the second story and caused a damage of approximately $6,000, principally on patterns.

S-14783. Wood planks laid across the pit in front of the brass furnaces became ignited from hot coals or ashes left in the pit over night.

Molding, Pouring and Casting.

H-9450. An explosion occurred when molten metal was being poured into a mold from a ladle. This mold had been prepared the previous afternoon and it is thought that the heavy dampness during the night allowed moisture to enter the mold, which was responsible for the explosion. Hot metal flew in all directions and set fire to the roof in several places and also to the motor house of a traveling crane which happened to be directly over the mold. Employees brought a nearby standpipe hose into service and with the aid of this and sand pails quickly extinguished the fire.

H-7134. A 33,000-pound casting had just been poured and everything appeared all right, when suddenly a stream of molten metal shot out of the pour-hole and extended to the roof, which was about forty-five feet high, and came in contact with the wood roof sheathing, which was ignited. Fire was quickly extinguished with standpipe hose.

S-15320. A ladle containing three tons of molten metal was being carried through foundry on a crane, when the key which holds the hoist driving gear worked loose, allowing ladle to gradually settle to the floor. In doing so it partially rested on a flask, tipping the ladle sufficiently to allow part of the contents to run out, which ignited the patterns and other combustible material in the vicinity. Three lines of hose from standpipes were used and these, together with five sprinklers which operated, quickly extinguished the fire.

S-11520. A piece of wet metal was thrown into a crucible of hot metal, some of which was blown from the crucible and scattered on some shelving where fire broke out after smouldering for about five hours.

Hot Castings.

H-3514. Flask containing hot castings was carelessly piled near elevator woodwork and allowed to remain there after plant shut down. Flask ignited and set fire to woodwork of elevator.

Flasks.

H-6152. Metal flasks while still hot were piled against side of wooden building. Building was burned with a total loss.

H-8421. Fire was caused by sparks left smouldering in pile of wooden bottoms to flasks.

Fuel Oil and Volatile Liquids.

H-8079. Fire is supposed to have been caused by the train crew backing freight cars into a gasoline tank, breaking the tank and spilling the gasoline over the ground. Fire from burning gasoline communicated to foundry buildings.

H-5343. The regular oil caretaker was away and two employees were sent to the oil shed to fill torches with kerosene. They tapped the wrong barrel, which contained japan dryer. Their lighted torches near this barrel caused an explosion.

S-11434. Sparks from emery wheel ignited an open can of gasoline. Seven sprinklers opened and quickly extinguished the fire.

H-5421. Fire started in an open finished frame composition-roofed automobile house occupied by a large automobile truck. A thirty-gallon gasoline tank in this structure exploded and spread fire over a distance of 100 feet. Efficient work by the fire department prevented fire from reaching the main plant.

H-9580. A workman started to repair a small leak in a fuel oil supply line near a one-story building. The leak had occurred the previous week, and before the oil was shut off a considerable quantity had escaped, forming a pool on the ground which was covered with a light fall of snow. Employee was using a blow torch to make repairs and this ignited the oil. Flames communicated to wooden window frames and door of building.

S-9627. Naphtha for use in core room was stored in a 250-gallon iron tank, buried underground at south of sand shed and easterly from the core house. The naphtha was forced out by sixty pounds air pressure, as needed, by operating the proper valves at the tank. The weather had been extremely cold and on this Saturday the naphtha failed to flow when air valve was opened. Instead of closing naphtha valve the employee carelessly left it open and started to look for a freeze-up in the air line, due to possible condensation. Fires were built on the ground along this air line, when suddenly the naphtha spouted out of the open valve and ignited immediately, so that before anyone had time to close the valve the entire side of the frame sand shed was ablaze. The air pressure was immediately shut off and four streams from the yard hydrants extinguished the fire in about ten minutes. The heat was sufficient to open three sprinklers in the core house, the fire having gained access through a belt opening in the brick wall.

Dipping Pipes in Tar.

H-9110. While being placed in a tar dipping tank which was approximately fifteen by eight by six feet in size, heated pipe set fire to contents. The flames from the burning tar flashed up and ignited the roof. Pipes were ordinarily heated to a temperature of 300 degrees, but were probably overheated in this instance.

H-8537. Cast-iron pipe was heated in oven before being dipped in tank of melted gas tar, and it is supposed that one of these pipes was overheated and caused the tar to ignite when it was dipped into the tank.

H-3420. A high wind blew sparks and coals from an open fire in the yard, used for heating iron pipe for tar coating, into hollow pile of flasks, bottom boards and lumber.

Miscellaneous.

H-1663. Employee lighted some straw to use as a torch. Fire from this communicated to a large pile of loose straw used in the process of making cores. Loss $30,000.

H-8199. Heat from under cupola ignited wood charging floor about ten feet from ground. Fire communicated to the roof.

H-10965. Fire started from spontaneous combustion in a bin of charcoal which extended from the floor to within three feet of the ceiling. There were three sprinklers over this bin, but only two opened. The third was found to be a 212-degree head.

H-6690. Sand was conveyed to frame sand house direct from bucket conveyor. During the day of fire, employees had a wood fire on hand car for the purpose of thawing out the sand. It is thought that a spark from this fire was carried into the sand house by the conveyor.

H-6284. This fire originated in the kitchen used in connection with the plant dining room. In the corner where the fire appeared to have started was located a gas meter connected with the gas stove. The meter was melted off and the ignited gas shot a blaze against the wooden partition which formed one side of enclosure for the heating flues. Fortunately it was possible to reach the valve of the gas supply pipe, and this was closed promptly.

S-12327. This fire occurred in a small frame building used for the storage of boxes in which was packed excelsior and bottles of sulphuric acid. The fire was due to the action of the sulphuric acid on the excelsior.

COMMON HAZARDS.

Heating.

H-9577. Fire was caused by an overheated coal stove in the office. The stove vented directly through the wood roof through an ordinary stovepipe poorly bushed.

H-8549. Fire started from overheating of a small stove in the office of shipping clerk. Fire in this stove was supposed to be drawn at night, but apparently the drafts were opened to allow the fire to burn out, thus causing the stove to become overheated.

S-10531. Base of fire box of boiler is cast iron set on a concrete foundation on which several pieces of floor joist had been imbedded during the construction of the foundation. Cast iron base had become

cracked, leaving an opening 1¼ inches wide and 7 inches long, through which the heat readily passed and charred the floor joist left in the concrete foundation. This ignited and caused the fire.

H-7629. Employee discovered wood sheathing around stovepipe burning. The porcelain insulation around pipe was found to have been broken and to have fallen away in places.

H-2792. A furnace was located in the office of this plant. As the basement was low, the precaution was taken to cover the joists over the furnace with asbestos and tin, but even so they became charred and gave way, partially due to the weight of the heavy safe which was immediately over them.

H-8838. One of the first employees to arrive in the morning built a small fire in the stove with waste paper and a little wood. The drafts were left on so that fire burned very freely. The iron chimney from this stove passed through the ceiling and up through the roof. Where it passed through the ceiling there was a collar, but none where it passed through the roof. Fire occurred in small space between ceiling and roof.

Miscellaneous.

H-7542. Watchman on his first round discovered a pair of overalls, which were hanging on the wall, on fire.

H-5813. The exhaust pipe from a gas engine was too near wooden partition and ignited the sill.

H-7253. A gas jet was used to warm the exhaust orifice of the compressed-air-operated elevator or hoist. The woodwork nearby became ignited from this gas jet.

H-6933. Fire was caused by a hot coal which dropped from plant locomotive while it was passing over a wood trestle. Fire was readily extinguished with one 2½-gallon extinguisher.

H-6926. Spark from plant locomotive blew under eaves where the weather boards were loose. Fire was easily extinguished by one hose stream.

H-6992. Fire was apparently caused by some of the office employees throwing a lighted match into waste basket as they were leaving at night.

H-6932. Oil on electric crane was ignited by sparks from motor. Fire was readily extinguished with one 2½-gallon extinguisher.

H-10263. Floors had been recently oiled and it seems probable that the fire was caused by spontaneous combustion of oil-soaked chips or waste.

H-2542. Fire started under stairway in what might be called a hole for storing everything which could be of use at some future time. It was probably caused by oily rags or smoking.

H-1824. Fire occurred in an electric locomotive which was being charged. It is supposed that some oily waste was left inside of the locomotive near the batteries, which warm up considerably when being charged.

S-16853. Fire was caused by spontaneous combustion of fine coal against damp wood partition.

Incendiary.

S-7104. This fire was of incendiary origin. The incendiaries had nine gallons of kerosene which they evidently proposed to distribute through the building, and a time fuse of candles and matches. They ascended the fire escape but did not succeed in opening window far enough to get into the building. One can of kerosene had been placed in the building, and evidently on lighting a match to see where it was the kerosene became ignited, the can probably having a leak in it. As soon as this happened they fled hurriedly, as the remaining eight cans of kerosene, time fuse and crowbar were found on the fire escape. Four sprinkler heads opened and the first warning of fire was given when water from them soaked through to the floor below.

2. MISCELLANEOUS STATISTICS.

Analysis of Loss.

All Foundry Fires.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim.....	14	17.7	27	11.0	3	2.6	44	10.0
Small Loss	45	57.0	176	71.5	63	55.2	284	64.6
Large Loss	20	25.3	43	17.5	48	42.2	111	25.4
Total with data given,	79		246		114		439	
No data	7		16		13		36	
Total . . .	86		262		127		475	

Relation Between Effect of Sprinklers and Losses.

(Buildings equipped with sprinklers.)

	Extinguished.		Held in Check.		Unsatisfactory.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	15	37.5	3	7.9	..	..
Small Loss	25	62.5	34	89.5	..	..
Large Loss	..	..	1	2.6	2	100.0
Total	40		38		2	

3. DAY OR NIGHT FIRES. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	46	54.2	103	40.4	24	19.5	173	37.3
Night	39	45.8	152	59.6	99	80.5	290	62.7
Total with data given	85		255		123		463	
No data	1		7		4		12	
*Total	86		262		127		475	

4. PLANT IN OPERATION.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in operation	40	54.8	115	50.4	29	25.5	184	44.3
Plant not in operation	33	45.2	113	49.6	85	74.5	231	55.7
Total with data given	73		228		114		415	
No data	3		11		13		27	
Total	76		239		127		442	

*Includes data on several fires obtained from Fire Patrol Reports.

5. HOW DISCOVERED.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee	35	48.6	104	44.1	36	30.0	175	40.8
Watchman	23	31.9	73	30.9	45	37.5	141	32.9
Thermostat	..	..	1	0.4	..	..	1	0.2
Sprinkler Alarm	3	4.2	9	3.8	..	..	12	2.8
Outsider	11	15.3	49	20.8	39	32.5	99	23.3
Total with data given	72		236		120		428	
No data	4		3		7		14	
Total	76		239		127		442	

6. EFFECT OF SPRINKLERS.

	No. of Fires.	Per Cent. of Whole.
Extinguished or practically extinguished fire	40	50.0
Held fire in check	38	47.5
Unsatisfactory	2	2.5
Total	80	
No Claim	18	22.5
Small Loss	59	73.7
Large Loss	3	3.8
Total	80	

7. UNSATISFACTORY SPRINKLER FIRES.

S-12871. This fire, from unknown cause, occurred in the electrician's room, which was a room forty by sixteen feet, of joist construction, located on the core oven roof, and adjoined and opened into the monitor on the foundry roof. It was accessible by stairs in the south end of foundry and was occupied for electrical repairs and storage of electrical supplies in wooden racks and bins.

A dry-pipe sprinkler system had been installed in the foundry and connected to the new yard system, but the contract did not call for sprinklers in the electrician's room. The yard system was supplied by a Knowles 1,000-gallon Underwriter pump taking suction from a six-inch city main through a six-inch National meter. A 50,000-gallon gravity tank had been erected, but was not in use, and there was no pressure on the yard system at the time of the fire. The sprinkler system was still in the hands of the contractors.

Fire was discovered by a train man and mill fire brigade notified. They had several streams in use before the arrival of the public department. An indicator post valve controlled sprinklers in the foundry and was opened soon after, but it was found that so many sprinklers had been fused that the water supply was inadequate, and the sprinklers were shut of after ten minutes trial. Loss about $7,000.

Summary: Unsprinklered portions and water shut off.

8. LARGE LOSS FIRES.

S-1100. Fire was discovered by the watchman in the core room in a pile of wooden boxes filled with small finished cores. He attempted to extinguish the fire with pails of water but was unsuccessful, so gave public alarm. Fire spread into storeroom where there were supplies of core boxes, and also ignited plank roof, traveling lengthwise in each direction. At the westerly end, fire was stopped by the corrugated iron partition of the repair shop. It burned up through the roof at the joints in the planking and along the lines of the trusses. The wooden roof of two-inch plank, with tar and gravel covering, was burned so that nearly all of it had to be replaced. Some of the trusses were warped and a few of the steel columns twisted, while the general expansion of the steel work started the rivets and gusset plates at points where the fire was most severe. The brick storeroom had a concrete ceiling on iron rails, an expansion of these rails wrecked the ceiling and cracked the walls so that the entire room had to be rebuilt. Loss $17,000.

This fire illustrates the possibilities of a large loss from a comparatively small fire because of unprotected metal members.

H-6347. It is thought that this fire, which occurred in a one-story frame pattern shed near railroad, was caused by a hot cinder from locomotive, which had passed the property several minutes before the fire was discovered. There was a large stock of patterns in the shed, piled on the floor and also on wooden racks and shelves at the north end. Most of these patterns were in use and they represented considerable value. Fire was discovered by employees who saw smoke coming from under roof of pattern shed. The engineer was immediately notified and started the fire pump, while the other employees in the main foundry building started to get out the hose. Four hydrant streams were used and it is said that the work of the private fire brigade was very efficient as the fire was practically extinguished in ten or twelve minutes. The loss was considerable, for many of the patterns were of light dry pine and were either painted or shellacked so that they burned quickly and furnished good fuel for the fire.

Valuable patterns should be stored in buildings of good construction and such buildings should be protected just as completely as the main foundry.

H-1492. Fire occurred in second story of a new brass foundry. This building was without sprinkler protection and was 163 feet long by 68 feet wide. Floors were of three-inch plank on timbers resting on steel beams and about one-third of the area of the second floor was of five-inch reinforced concrete covered with five inches of clay. Roof was boarded on joists supported on heavy wooden roof trusses resting on angles bolted to the steel columns in the walls. There was a large wooden monitor extending nearly the whole length of the building. In the northeast corner of the storage room was located a brass melting furnace (Swartz brass melting and refining furnace) which burned fuel oil. This brass furnace resembles a small convertor such as is used in making Bessemer steel. When combustion of the oil takes place inside of the furnace, a flame about a foot long comes out of the upright mouth of the furnace. There was a heavy iron hood, nine feet eight inches by five feet, about eighteen inches above the mouth of the furnace and a round iron stack extended from the hood through the roof for a distance of fifteen feet above the roof. The woodwork of roof was cut away for a space seven to nine inches from the stack, and a sloping sheet-iron collar fitted around the stack down on to the roof boards. This arrangement left a good-sized air space, but was apparently not watertight, so that a sheet of tin or sheet iron was placed on the underside of the roof boards, fitting tightly around the stack and being nailed to the roof boards.

With the furnace in continuous operation, the iron stack became very hot, and it appears to be a well-established fact that the fire originated in roof boards a little to one side of the stack and was apparently caused by the heating the sheet tin or iron on the underside of the roof boards, which, in turn, ignited the roof. Although promptly discovered and fuel oil supply shut off from the furnace, the fire spread rapidly. Parts of the roof and most of the large monitor were burned completely off. Considerable machinery in the foundry was badly damaged by fire and the loss amounted altogether to about $30,000.

9. POINTS OF INTEREST FROM FIRE REPORTS.

Automatic Sprinklers.

H-6235. An explosion occurred in the main building of this foundry about 8.30 p. m. which did considerable damage. Plant was in operation and it was thought the explosion was caused by the overturning into a pool of water of a large ladle holding several tons of melted iron. Melted iron was thrown into all parts of building and the roof immediately above was ignited. The force of the explosion was sufficient to break all the windows of this building, and in some instances even the window frames. An approved sprinkler system was being installed at this time but had not been placed in operation. Fortunately the system was being tested for leaks and the water was on, although the gates were partially closed. The gate in the six-inch connection from the twelve-

inch city main and the post indicator valve were opened immediately after the explosion. Until the former was opened the only supply was through a four-inch connection from the city main and a two-inch by-pass around the gate valve. About 325 of the 360 sprinklers in the building were opened. Most of these were probably fused by the hot blast from the explosion, as the only indications of fire were directly over the place where explosion occurred, a monitor and a small part of the roof being destroyed. The sprinkler system was apparently a factor in holding the fire in check. Forty-two men were seriously injured, four of whom died soon after the explosion.

S-4597. The efficient work of the sprinklers was very noticeable in this fire. The frame wall was badly burned and offered considerable obstruction to the distribution of the water. However, the six sprinklers which operated had practically extinguished the fire by the time the watchman, who was attracted by the operation of the sprinkler alarm valve, reached the building. The action of the sprinklers and the alarm valve no doubt prevented a total loss on this building, for it is a considerable distance from the main plant and watchman would probably not have discovered the fire until it was beyond control.

S-11924. Fire broke out in pattern loft of brass foundry under wooden shelf used for the storage of patterns and core boxes. There was a metal hood over the shelf at time of fire. The heat opened a sprinkler at each end of the shelf and although these operated satisfactorily and confined the fire to place of origin, they could not extinguish it on account of metal hood. The watchman discovered the fire on his regular round and completed its extinguishment with a two and a half gallon extinguisher.

S-13948. The sprinklers in charging floor room were controlled by a valve in foundry, which was ordinarily shut off. The watchman had been instructed to turn this on immediately in case of fire, but owing to his becoming excited he claimed he could not open it. This, however, was not true, as it was easily opened later by one of the foremen and found to be in perfect order.

S-6087. Fire started in an unsprinklered section in room used for pattern storage. Fire must have been very severe, but the old Niagara sprinklers in the adjoining room prevented it from spreading in that direction, while the practically blank walls on the other side of the room made it possible to confine the fire to this room.

Standpipes.

H-5649. Watchman with the aid of others immediately put into use both the inside hose from main building and outside hose, and in this way were able to confine the fire and practically extinguish it before the arrival of the fire department.

H-9567. Fire was discovered by employee in the foundry and he immediately brought into use a stream from nearby standpipe. Although the roof was very high at this point, the city pressure was sufficient to carry the water well into the fire and it was soon extinguished.

Watchman.

H-7954. It was the custom at this plant to dry the lumber for the pattern shop by placing it on top of the core oven. It was reported that fire could have been extinguished with ordinary chemical extinguishers, but the watchman, after telephoning the fire department, ran around waking up the employees who lived in the vicinity, instead of attempting to extinguish the fire.

Roof Hydrants.

S-17099. Fire was discovered in frame metal clad building eight feet north of foundry. As soon as the employees arrived at the plant they climbed to the roof of foundry and did very effective work with hose attached to the roof hydrants, by keeping the surrounding roofs of buildings wet down. The new foundry had not been equipped with open sprinklers and fire entered through the windows at the gable end, opening four automatic sprinklers inside the building which prevented the fire from gaining headway. Open sprinklers were turned on and they effectively protected the old foundry from the fire.

Doors and Windows.

H-10139. A tin-clad trap door at stairs operated automatically by the melting of a fusible link and did excellent service in keeping fire from the upper floors of this section. The fire department found the automatic fire doors leading into foundry blocked open, and the ceiling of the foundry was on fire when they arrived. When the obstruction was removed from the door, it closed automatically. The seams of the tin-clad fire door and trap door, which were not made in a standard manner, had opened up to a considerable extent and the interior had become charred.

H-4954. One of the interesting features of this fire was the fire-resistive qualities shown by the wired glass in the metal frame skylight over the boiler room. Although exposed to great heat, it held intact with the exception of a few cracks. It was also noticed that the mortar was defective in the brick walls. Some of this mortar did not have sufficient lime to make it adhere to the brick, or else it was put on dry.

Miscellaneous.

H-6701. The patterns were thoroughly wet down, but the loss to these was considerably reduced by the owner's good judgment in taking care of them before they became water-soaked.

H-4876. The blast furnace (just being put in blast at time of fire) has been banked with coke fires and it is hoped that it may be kept from chilling until a new blowing engine can be secured to replace the one destroyed by fire.

H-1757. Fire was caused in some way by enameling furnaces igniting woodwork. The building was about 300 feet long but without proper fire walls, so that fire spread quickly throughout the entire structure.

H-9611. Fire was caused by a spark from core oven. The large loss was due to the inadequate cut-offs, for the fire, which was immaterial at first, ate its way up the roof timbers, through the frame partition, and spread under roof of main foundry, practically ruining all steel roof supports.

10. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory *		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Waterworks,	60	76 0	68	6.2	30	50.0	29	48.3	1	1.7	69	69	40	3.7	9.6
Gravity tank,	9	11.4	37	19.5	5	55.6	4	44.4	.	....	30	49	..	2.6	40.7
Pressure tank,	5	6.3	78	23.0	3	60.0	2	40.0	.	....	77	80	..	10.1	40.5
Automatic pump,	5	6.3	89	22.4	2	40.0	3	60.0	.	....	77	98	..	50.0	4.0
Total,	79	100.0	67	9.8	40	50.6	38	48.2	1	1.2	65	69	40	6.0	14.0

11. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	1	1.3	13	7.0	..	....	1	100.0	.	....	..	13	..	...	7.0
15 to 24 inclusive,	4	5.1	20	1.2	3	75.0	1	25.0	.	....	21	19	..	1.0	2.0
25 to 49 inclusive,	15	19.0	38	12.3	5	33.3	9	60.0	1	6.7	38	39	40	2.4	19.2
50 and over,	59	74.6	78	9.7	32	54.2	27	45.8	.	....	74	84	..	7.0	13.0
Total,	79	100.0	67	9.8	40	50.6	38	48.2	1	1.2	65	69	40	6.0	14.0

12. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	47	59.5	65	6.9	23	48.9	23	48.9	1	2.2	66	64	40	2.9	11.3
Dry System,	32	40.5	70	14.0	17	53.3	15	46.9	.	...	63	78	..	10.2	18.4
Total,	79	100.0	67	9.8	40	50.6	38	48.2	1	1.2	65	69	40	6.0	14.0

* Does not include one unsatisfactory fire for which data was not complete.

13. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Waterworks,	60	76.0	68	6.2	14	23.3	45	75.0	1	1.7	69	69	40	2.5	7.4	..
Gravity tank,	9	11.4	37	19.5	2	22.2	6	66.7	1	11.1	27	40	50	1.0	19.3	58.0
Pressure tank,	5	6.3	78	23.0	2	40.0	3	60.0	..	....	69	85	..	1.0	37.7	..
Automatic pump,	5	6.3	89	22.4	..	....	5	100.0	..	....	..	89	..	..	22.4	..
Total,	79	100.0	67	9.8	18	22.8	59	74.7	2	2.5	64	68	45	2.2	11.5	58.0

14. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	1	1.3	13	7.0	..	....	1	100.0	..	....	..	13	..	...	7.0	...
15 to 24 inclusive,	4	5.1	20	1.2	2	50.0	2	50.0	..	....	23	20	..	1.0	1.5	...
25 to 49 inclusive,	15	19.0	38	12.3	3	20.0	11	73.3	1	6.7	40	36	40	1.0	16.7	...
50 and over,	59	74.6	78	9.7	13	22.0	45	76.3	1	1.7	76	79	50	2.6	10.8	58.0
Total,	79	100.0	67	9.8	18	22.8	59	74.7	2	2.5	64	68	45	2.2	11.5	58.0

15. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	47	59.5	65	6.9	11	23.2	35	74.5	1	2.3	68	64	40	2.1	8.6	...
Dry system,	32	40.5	70	14.0	7	21.9	24	75.0	1	3.1	58	74	50	2.3	15.6	58.0
Total,	79	100.0	67	9.8	18	22.8	59	74.7	2	2.5	64	68	45	2.2	11.5	58.0

Note.—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

General Fire Record.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

S-17649. Tenant Manufacturing. This property consisted of a five-story and basement brick building, 28 by 180 feet, together with two ells on the south side, 28 by 60 and 28 by 90 feet respectively. The sprinkler system was originally installed by local plumbers in 1888 with pendant "Mackey" sprinklers on wet-pipe system, not staggered, on old standard pipe sizes. In 1913 the sprinkler heads were mainly replaced with approved heads, but no changes were made in the pipe sizes or spacing. The secondary water supply, consisting of a 20,000-gallon tank, with forty-foot elevation, was also installed at this time. The primary water supply consisted of high service waterworks on a six-inch main, with static pressure of sixty pounds.

Story of the Fire: The fire evidently started on the first floor in a pool room at or near a stove. It appears to have worked its way up through the wood-sheathed partitions into the wood-sheathed ceiling and into a two-foot blind space below the ceiling. Four sprinklers on the first floor near the stove opened and confined the fire there to the corner of the room where it started. No other sprinklers opened on this floor. The fire then worked its way up to the second floor through the sheathed partition, opening all fifteen sprinklers there which appeared to have operated satisfactorily, and still confined the fire to the corner of the building. However, the flames continued to the third floor, where again all the fifteen sprinklers operated, but from indications on the ceiling the water supply was weaker than on the floor below, for the area covered on the ceiling was only two feet in diameter at each sprinkler, while on the second floor it was about five feet. The fire started to spread on this floor, but was still confined to the corner. On the fourth floor, however, the fire spread, fusing all the fifteen sprinklers, but there was no indication that any water was discharged from them. The frame enclosure at the elevator was entirely destroyed and the ceiling sheathing was scorched. A part of the ceiling sheathing was ripped down by the action of the water tower, and carried with it a part of the sprinkler lines, although the pipes were not broken. The fire spread to the fifth

floor, where the greatest fire loss occurred. All the sprinklers on the fifth floor, including those in the pent house, fused, but there was no evidence of water being discharged on this floor. The fact that there were signs of sufficient water being discharged from the sprinklers on fourth and fifth floors of main building, and no signs of water being discharged from sprinklers on the fourth and fifth floors of this ell where fire started, shows conclusively either that the two and one half inch riser was not large enough to supply more than the thirty-five sprinklers that were operating on the first three floors, or else the riser and pipes above the third floor were plugged with sediment. It is evident that the secondary supply was a factor in this fire, because the tank was found practically empty. Fire was finally extinguished by the public fire department with water tower and fourteen hose streams. Loss was approximately $50,000.

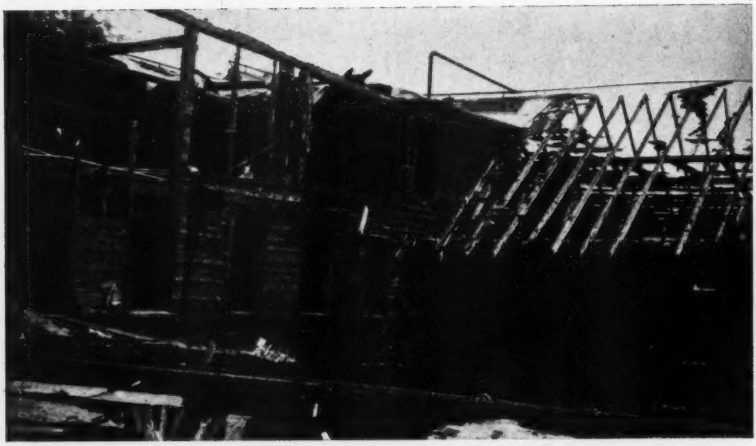
Summary: Concealed spaces and sub-standard pipe sizes.

S-17861. Chrome Tannery. Buildings of this plant were from one to three stories and basement in height, wooden walls, floors and roofs. The property was partially sprinklered with both obsolete and modern

S-17861.

View of Buildings after Fire.

approved heads. Fire started on the second floor of the two-story section used for buffing machines. The exact cause is unknown. One of the employees passing through the room saw fire and notified the engineer. The mill whistle was blown and public alarm sent in. The fire department responded and used ten streams. As the fire started in an unsprinklered room it spread quickly, and although the sprinklers in the adjoining buildings kept it from gaining great headway, it practically destroyed the roofs and walls adjoining the unsprinklered building. The sprinklers operated with good effect, and probably saved the remainder of plant from total loss.



S-17861.

View of sprinklered area taken from unsprinklered section where fire started.

The effect of the sprinklers was satisfactory, as the unsprinklered portions were entirely consumed, while the sprinklered portions, except the roof, were left standing. All of the heads within reach of the fire, with the exception of a few old Grinnell metal disc sprinklers, opened.

S-17525. Shoe Factory. This property consisted of a three-story frame building in the form of an ell, with a brick boiler house one story in height at east end. There was a brick-frame, one-story engine room attached to the boiler house. Engine and boiler rooms were cut off by a parapetted brick wall with one opening protected by a good automatic fire door. All to the west of this fire wall was sprinklered and occupied as an ordinary shoe factory, while all to the east of this fire wall was without sprinklers. The shoe factory portion was sprinklered under old pipe sizes, and supplied primarily by town water, with sixty pounds pressure, through a six-inch connection from a six-inch street main. Secondary supply was a 50,000-gallon gravity tank. The town pumping station was located about a quarter of a mile from the plant. It was equipped with two pumps, but owing to the deficient boiler capacity only one could be run during the fire. The water supply was taken directly from a standpipe thirty-five feet high and thirty feet in diameter, holding 185,000 gallons of water when full.

The watchman had started the boiler fire early in the morning, and was burning a lot of wood waste in order to get rid of it as soon as possible. He started on his round, and had reached the second floor of main building when he heard the sprinkler alarm ringing. He returned to the boiler room, and found the shavings were on fire. In spite of his efforts the fire

spread quickly and entered the main plant. From the best information obtainable it was apparent that the sprinklers operated satisfactorily. The watchman, on entering the boiler room, thought the fire was out, and shut sprinkler valve controlling the ell, and opened the drip valve. Meanwhile the fire had spread from the top of boiler room into the first story of ell, where it made rapid headway over the cases of shoes and dry timber. The long runs of six-inch main were insufficient to supply enough water for the large number of sprinklers which opened.

Summary: Water shut off and deficient water supply.

S-17412. Wool Shoddy Mill. Construction: Two and three story brick building, open finish; floors of plank and timber; stairs and elevators cut off.

There appears to have been practically two separate fires in this property. The first fire was a characteristic picker-room fire, originating in breaker picker using low grade wool rags. This fire opened five or six sprinklers which, with other appliances, practically extinguished the blaze. The foreman of the picker room ordered sprinklers shut off at section control valve in boiler room, which was done. He then ordered numerous windows facing west of picker house to be opened in order to carry off the smoke. It was stated that a very strong wind was blowing, and as soon as the windows were opened fire again started in this picker house. An employee was immediately sent to the boiler house to reopen the sprinkler valve, but he apparently became excited, and instead of opening the proper valve he either opened a drain or closed some other sprinkler gate valve. On account of the dense smoke it was not noticed that the sprinklers were not operating until the fire had obtained great headway, and had extended to main manufacturing section through stock conveyor pipes (eighteen-inch metal ducts).

Public fire department responded promptly, but by the time they reached the fire one third of mill was in flames. Private fire brigade was fighting the fire with two hose streams supplied by a 750-gallon Underwriter steam pump through standard fire doors which cut off the manufacturing section from the engine and pump room in the first story and which, in turn, were cut off in a like manner from the boiler room and warehouse section. There seems to have been no further attempt made to open sprinkler valve, which it would have been possible to have done, since the valve was located in the rear of the fire-resistive, one-story, cut-off boiler room, and within a few inches of a light glass window, opening to the outside. The fire made such great headway, that when the fire department responded they were unable to check its progress, and the entire plant was destroyed.

The exterior brick walls are still standing, also roof of fire-resistive boiler house, and portions of fire doors are in place, but show results of great heat and are all more or less destroyed. Doors were probably blocked open for the purpose of playing hose streams through openings, and were abandoned hurriedly and without removing blocking which held

them open. The manufacturing portion of this plant was a modern plank and timber building with brick walls, two stories in height, 60 by 150 feet, and adjoined an old warehouse section 50 by 200 feet, where raw and finished stock was stored. The loss was nearly total, and was approximately $200,000.

Summary: Water shut off and indifferent fighting of fire.

S-17618. Wall Paper Factory. This disastrous fire destroyed the entire main building, which was two stories in height, about 60 by 280 feet in unbroken area, with yellow brick walls and numerous unprotected window openings on all sides, joisted board floors with joisted roof covered with slag. Stairways and elevators were poorly cut off. All of the contents were destroyed, consisting of wall paper in process of manufacture or rolling, coating machines, mixers, etc. The warehouse, fifteen feet distant from this main building, escaped with a damaged cornice and a few broken windows. Fortunately the wind was in the direction to aid the firemen in saving this latter building.

The day watchman had completed his five o'clock round, and after putting on his coat and hat stepped outside of office to wait for the night watchman who was due at six o'clock to relieve him. A man suddenly rushed up to the day watchman and said there was smoke coming out of the factory. Just then he heard the town fire bell and also the sprinkler alarm bell ringing. The two men got out a hose line and tried to enter the second floor, but the smoke drove them back and this line was turned over to the fire department on its arrival. The local volunteer fire department responded with a hose reel and automobile combination hose and chemical and a horse-drawn steamer. The chief of the fire department, upon his arrival, quickly got two steamer streams into use and summoned assistance from neighboring places.

The sprinkler system seems to have completely failed. The entire contents of the 25,000-gallon gravity tank ran out, and the tank burned. All the valves are said to have been open, and there is no evidence to the contrary, although but one fireman was found who said positively that he saw any heads operating. The day watchman claims that he opened the waterworks valve soon after the firemen arrived, and the chief of the fire department corroborates this by stating that he noticed a drop in pressure soon after his hose streams were put on. He did not actually see any sprinklers operating himself, but he states there appeared to have been some retarding force at work on the inside of the building. Altogether it seems fair to assume that sprinklers operated properly, and that their failure to extinguish or hold the fire in check was due to the fact that fire originated over a large area, while obstructions of some kind evidently prevented the first heads which opened from reaching the seat of flames, and further that the weakness of the water supplies, both in capacity and initial pressure (static pressure on sprinklers operating twenty-four pounds), combined with the large unbroken area (17,000 square feet) and the inflammable nature of festooned stock of wall paper, was too great for the sprinklers to control the fire. Loss, $75,000 to $100,000.

Summary: Weak water supply and possible obstruction to distribution.

S-17695. Tenant Light Manufacturing. Building was of joist construction with double floors, the lower floors being about twelve inches wide, and the upper boards of ordinary yellow pine flooring laid the same way as the lower boards. Ceiling on the first floor was sheathed with heavy tin and was fairly tight. The arrangement of the upper floor boards left cracks in places between these boards, and gave the dust an opportunity to sift down into hollow space between the joists.

Fire occurred from unknown cause among the joists at the second floor (first floor ceiling), at the extreme end of the building against the west wall. The watchman heard the sprinkler alarm on the outside of the building, and he immediately pulled the public fire alarm box. When the fire department reached the first floor of building, they could see a faint light from fire up between the joists above the sheet metal ceiling at end of building. The ceiling was torn off, and hose streams quickly extinguished the fire. Some trouble was then experienced in shutting off sprinkler system on this floor, since the valve at riser would not close tightly, and the patrol finally shut off all valves on the other side of building, and drained the tank out through the main riser. It is evident that the one sprinkler which operated was unable to reach the fire, which was protected by the metal sheathing of the ceiling. It could not be learned how long this sprinkler was in service, but from the delay in shutting off the water it was probably in operation for some time.

Summary: Concealed spaces.

S-16691. Sawmill. Fire started at 4.15 a. m. from unknown cause in the hopper of sawdust collector, and spread very rapidly to the open, frame, unsprinklered light lumber storage sheds which adjoined and communicated with the sprinklered two-story frame mill building and lumber in piles in yard.

The watchman started on his four o'clock round promptly, and in passing the sawdust hopper discovered the fire. He went directly to the city fire alarm box (which was located about 200 feet from where fire was discovered) and inserted the key, but owing to the recent coat of paint which the box had been given (which was a mixture of red lead and varnish and had penetrated the crevice around the door and hardened), he was unable to open the door and was compelled to abandon the box. The alarm was finally sent in by a policeman some blocks from the plant. This caused considerable delay, and the fire gained great headway before the arrival of the fire department, which was further handicapped by small water mains in this section and low water pressure.

The sprinkler equipment in the mill building was a two-source, six-inch, dry-pipe system, straightway valve, installed in 1908. The initial source of supply was from a four-inch city line, with a normal pressure of sixty pounds. The second source was from a 15,000-gallon gravity tank on a sixty-foot steel tower, located near the sawdust hopper and surrounded by open, frame, unsprinklered lumber sheds and mill building.

All valves in the supply line to system were found open after the fire, which is evidence that the sprinklers had been in operation, but the fire was so severe when it reached the sprinklers that they were unable to check it, proving again that sprinklers are unable to hold in check fires originating in unsprinklered sections which communicate the fire to the sprinklered area, and also proving that steel tank towers when seriously exposed should be enclosed in concrete or other fire-resistive material.

Summary: Unsprinklered portions.

S-17617. Wool Storehouse. This fire started from unknown cause near corner of the building, against the wooden partition of sorting room. In this part of the room wool was stored in bags and bales, and most of the stock had been in storage for some time.

The sprinklers in the building were on the dry pipe system and thirty-three of them opened, but the sprinkler equipment was not efficient because the heads and piping were clogged with pipe scale sufficient to obstruct the flow of water at many of the heads. This system was formerly shut off in winter, the dry pipe valve having been installed within a year. Fire was first discovered by an employee in the yard, and as soon as the alarm was given the private brigade promptly laid four lines of hose and the fire pump was started. The smoke was dense and consequently a great deal of water was poured into the building before the fire was extinguished. Loss $1,500.

Summary: Clogged pipes.

S-17791. Metal Worker. This fire occurred in peak of roof, in concealed joist channels of the attic of building occupied for finishing and wrapping coffee grinders. The roof was slate covered on boards on joist, with wood sheathing under the peak. The actual fire damage was limited to the charring of the joist channels and sheathing, for the prompt response of fire department prevented the spread of the fire. The automatic sprinklers were not a factor, as there were no heads in this concealed space and the water from the one head which did open was unable to reach the seat of the flames.

Summary: Concealed spaces.

S-17657. Manufacture of Men's Clothing. Fire starting from unknown cause in this two and three story joisted brick building resulted in a loss of $4,200. Fire apparently started under basement stairs and burned through wood lath and plaster stair enclosure to joisted spaces back of metal ceiling. The prompt and efficient work of the fire department prevented a total loss. The comparatively large loss was due to the fact that the sprinkler system, for some unknown reason, had been shut off and the pipes drained.

Summary: Water shut off.

S-17632. Knitting Mill. A few moments after the card room had begun operation in the morning, the overseer of that room noticed fire as it flashed over the first breaker. As soon as possible three or four of the small hose streams in the room were used, and these, together with the forty-seven sprinklers which opened, extinguished the fire in about half an hour. Water from the sprinklers and hose streams badly damaged the clothing on nine sets of woolen cards so that the total loss was approximately $7,000. It was noticed that the circles on the ceilings over the sprinklers varied, some of these being very prominent and others slight. Slight markings were especially noticeable in that part of the room where fire started, which was under the end head of a branch line. An examination of the sprinklers showed no fusing of the metal parts, and a test of the water supply was made by removing a sprinkler over the point where the fire started and attaching a small hose to the branch line. This test showed the piping to be clear, as a good stream of water was obtained. The owner was positive that there was water on the sprinklers, and it would appear that the latter may have been slow in operating. This fact, together with more or less lint on the floor and ceilings, permitted the fire to spread rapidly.

S-17631. Paper Warehouse. This storehouse was used for the storage of paper in rolls. It had a dry-pipe sprinkler system controlled by a five-inch valve located in a near-by pulp mill. The supply of water came from the sprinkler system in this latter building. The night watchman heard the alarm valve and on investigation found smoke coming from the storehouse. He at once gave a public alarm. The fire department promptly responded and used three hose streams. The roof where the fire started was quite badly burned and all the sprinklers in the building (eighty-two in number) opened.

The failure of the sprinklers to control the fire was so unusual that an investigation was made to determine the cause, as the sprinklers evidently did not have a proper supply of water. The superintendent stated that he was present at the fire and that the valve controlling the system was not closed until fire was extinguished. An examination of the dry-pipe valve showed that it had tripped properly. On making tests with gauges of the riser in the pulp mill (from which source the water for the storehouse sprinklers was obtained) and on the hydrant near the penstock it was found that with a two and one-half inch pipe open there was a drop in pressure between these two points of seventy-five pounds. The underground pipe running to supply these sprinklers was then dug up and found to be but three inches in size and of wrought-iron pipe which had been in the ground considerable time. Loss $7,500.

Summary: Deficient pipe sizes.

S-17769. Waxed Paper and Clothing Manufacturers. Fire started from unknown cause in second story of building occupied by a paraffine paper coating company. Fire practically destroyed the three-story brick building of open joist construction and the two-story portion of building

No. 5 adjoining. A twelve-inch brick fire wall, together with a good fire door into the picker house on the east, held; and this building was not damaged. The public fire department used about ten hose streams, and due to their efficient work fire was confined to building of origin.

The reason for the large loss was due to the fact that the post indicator valve controlling sprinklers in this building was shut at time of fire. Two days previous the superintendent made his regular weekly inspection of sprinkler system and claimed it was in order, while on the Tuesday before the fire, an insurance inspector also reported all fire appliances in order. The post indicator valve was not open at the time of fire and the building was all ablaze when the fire chief arrived, who decided that to open the valve would cause such a reduction in pressure as to seriously affect the hose streams.

Summary: Water shut off.

S-17607. Furniture Factory. This was a two-story frame building. Plant was shut down temporarily for boiler repair, and the buildings were without steam heating service, so that coal stoves had been installed for temporary use. These stoves were placed directly on the wood floor with a short length of pipe extending through the windows in a tin shield set in the place of one pane of glass. It is probable that these stoves were in some way the cause of the fire. Fire was discovered by an outsider, who telephoned the fire department. They responded promptly and used four hose streams to good effect, and in consideration of the type of building and inflammable nature of the contents, it was apparent they must have done very good work to save any of the property.

The sprinkler system was shut off at the control gate on the first floor and the pipe above this had been drained to prevent freezing while the boiler was out of service. Boiler had been repaired and plant was ready to start operation again on December 30th. In the interval the coldest weather of the season was experienced, and when an attempt was made to restore sprinkler protection it was found that the water below the outside screw and yoke gate valve had frozen and split the valve casings and the valve came apart, allowing a six-inch stream of water to flow into first floor. Considerable damage was done before the city gate valve could be shut. A new valve was at once ordered and plant resumed operation without sprinkler protection. When the valve arrived it was found that an error had been made and it could not be used. Another valve was ordered and an extension of time for shutting off sprinkler system secured from the insurance companies. On January 20th the boiler tubes developed leaks and it was necessary to again shut down the plant. Temporary stoves were installed for heat, as previously outlined, and on February 1st the fire occurred. The loss of $11,000 was due to damage of stock on second floor and considerable water loss on stock of machines on first floor.

Summary: Water shut off.

Small Fires Which Resulted in Heavy Loss from Water.

S-17707. Cotton Mill. Fire started in mule head in mule room located on the top story of No. 1 mill. A considerable amount of smoke was given off, which prevented the mill brigade from determining whether or not the fire was under control; consequently they used two large hose streams, although it is probable that the three sprinklers which opened would have controlled the fire. The considerable amount of water discharged ran down through the floors below, wetting the roving frames therein and also some roving which was stored in the basement. An effort was made to cover some of the machinery in the floors below, card covers being used for this purpose, and part of the roving stored in the basement was moved out, but the central portion of No 1 mill was generally well wet down. Loss, about $2,000.

S-17775. Shoe Factory. Fire occurred early in the morning on the fifth floor, which was occupied as a cutting room. The fire started under a cutting bench and was confined there. The building was of brick construction, five stories and basement in height, with joist floors and open finish ceilings. When the fire department responded they found that the two sprinklers which had opened had held the fire under control and it was quickly extinguished by one stream from chemical engine. The actual burning was confined to the cutting bench previously mentioned, but the water from sprinklers had spread pretty well over the entire fifth floor and leaked through all the floors below to the basement. The occupancy of these floors was as follows: fifth, cutting room; fourth, lasting room; third, lasting and making room; second, stitching and cutting room; first, offices and shipping; basement, stock storage. Loss, $14,054.

S-17748. Candy Manufacturing. Fire occurred in a cold air chocolate room on the fifth floor of this six-story brick building, with floors of joist, plank and timber. The room where fire occurred was always kept locked and the watchman did not cover it during his rounds. Forty-eight (all) sprinkler heads operated, although the fire was confined to a small frame rack of light construction. The reason for the operation of all the heads was probably due to the peculiar construction of the room, which had frame sides with a three-inch cork insulation on walls and ceiling, finished with about one inch of cement. All the windows to outside of building were of wired glass with a secondary window inside. Because of tightness of cement finish the heat from blaze quickly filled the room before the arrival of water to sprinkler system from the dry valve in basement.

The firemen upon their arrival used a hose stream to puncture windows of room to allow smoke to get out, and in so doing probably opened many of the sprinkler heads. The loss was considerable, due almost entirely to water damage. The entire water supply of 20,000 gallons was exhausted and this together with a five-minute supply from the fire engines, left an excessive amount of water on the floors, and since these were of laminated planks, the stock and plaster board ceilings on lower floors suffered considerable damage, Loss, $7,525.20.

S-17750. Manufacturer of Sweaters. Fire started near the entrance on the sixth floor, apparently in a pile of cloth clippings. This building was six stories and basement in height, with brick walls and joist floors. Fire spread to nearby wooden partition and shelving, but was confined to a small area. All but three of the sprinklers in the room opened and the fire department upon its arrival pumped directly into the system through steamer connections, and did not use public hydrants nor hose streams. Owing to the dense smoke from the burning knitted goods it is probable that the fire was extinguished several minutes before the steamer stopped pumping or the water was shut off. Damage from fire alone was small, being confined mainly to wooden partitions and stock shelves. The water damage, however, was heavy, as both gravity tanks (total 13,000 gallons) were drained, and there was considerable water pumped into the system by the fire department. The water leaked through all the floors below.

The occupancies and losses were as follows: fifth floor, manufacture of cotton and muslin petticoats, loss $8,000 from water, no fire damage; fourth floor, cigar manufacturing, small loss from stock being wet down; third floor, cigar manufacturing, loss $2,000; second floor, small department store, loss unobtainable, but considerable from wet stock; first floor, occupied as a market, loss slight.

S-17741. Slipper Manufacturing. Fire started from unknown cause in stitching room on the fifth floor in the west section of the building. This building was six stories and basement in height, with brick walls and plank and timber floors. When the firemen arrived the sprinklers had the fire well in check and it was quickly extinguished by the former. Fire evidently started under a bench where sprinkler could not reach it. This gave it a good start and created considerable heat. It is said that the firemen were handicapped because the room was full of smoke and that the sprinklers had to be again turned on after they were shut off. This may account for the fact that a total of sixty-three sprinklers opened for this small fire. The actual burning was confined to a space of 20 by 10 feet and the fire loss was only $200, but the opening of so many sprinklers caused a large water loss on this floor and the floors below, although the firemen saved considerable damage by covering stock with blankets. The total loss was adjusted for $11,285.25.